APRIL 1964 35 CENTS ICD

SCIENCE DIGEST

Hugh Downs: How to see the Fair without going

FLUORIDATION FIGHT IN N. Y.

WHY THE WEATHERMAN OFTEN GUESSES WRONG

A satellite is born

ECHO II, the world's largest spacecraft, was rocketed into orbit on Jan. 25 from the Pacific Missile Range in California.

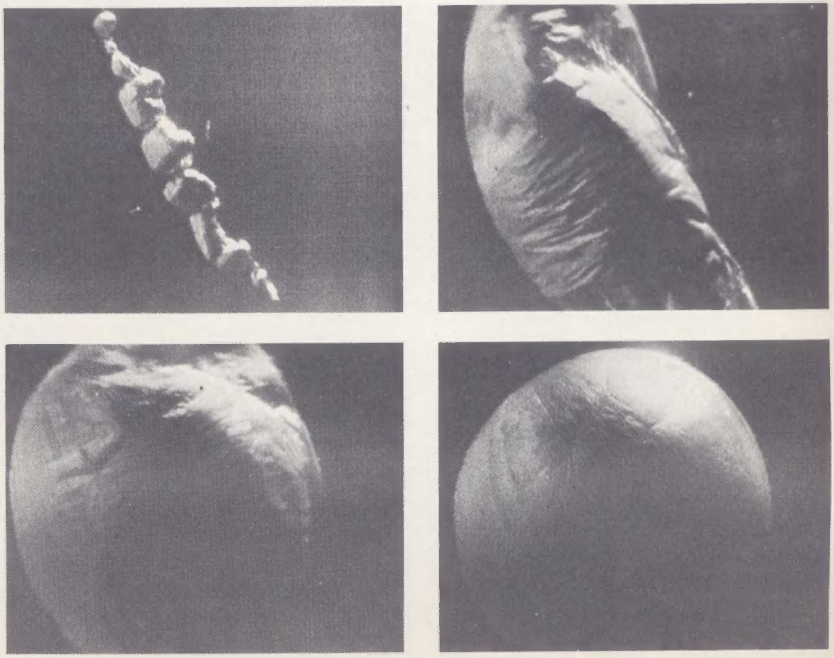
The 13-story "Satelloon" was packed, uninflated, in a pill-shaped canister atop a rocket. Folded, Echo II rested in a compartment 39.6 inches in diameter and 29.3 inches deep. One hour after the launching, the 135-foot-diameter plastic and aluminum sphere opened and inflated 800 miles above South Africa.

The dramatic series of photos below of Echo inflating were taken by the TV camera of the Angena launch vehicle. The camera transmitted the pictures to a ground station at Pretoria, South Africa.

After the canister dropped away, the spacecraft looked like a large sausage for a while, then it slowly filled with gas into its proper shape, a soft round ball.

Echo II, like its predecessor Echo I, is an experimental communications satellite, used to reflect radio signals beamed to it.

During its lifetime in orbit (scientists expect it to last for years), the Satelloon will be viewed by more people than any other man-made object in space.



As viewed by TV camera in rocket that hoisted it into space, Echo II puffs itself up.

SCIENCE DIGEST

Twenty-eighth year of publication

Hugh Downs, host of the popular "Today" show, tells the millions who will be unable to go to the New York World's Fair how they will be able to see it all summer on television. A special World's Fair section starts on page 8.

APRIL • 1964 VOL. 55, NO. 4

ARTICLES

A SATELLITE IS BORN.....Inside front cover
THE WOMAN WHO TELLS COLOR BY TOUCH..... 5
WORLD'S FAIR: HOW TO SEE IT WITHOUT GOING..... 8
WORLD'S FAIR: WILL THIS BE THE NO. 1 SHOW?.....13
WORLD'S FAIR: WHAT'S NEW AND WHAT ISN'T.....20
NEEDED—UMBRELLA WEATHER FORECASTING.....25
FLUORIDATION: WHY NEW YORK DECIDED TO ACT.....30
FLUORIDATION: DOCUMENTING THE CASE AGAINST IT.....34
VROOM! OUT OF THIS WORLD ENGINES.....40
MEET THE GHOST KANGAROO.....48
HOMOSEXUAL MEN AND WOMEN.....55
WAY OUT QUIZ.....66
MAN'S ETERNAL FRIENDS AND ENEMIES.....69
HE FOUND THE "BLOODY CITY".....73
INDIA FIGHTS THE BIG COUGH.....74
SORRY, EMPIRE STATE.....85
TRIPLE BLIMP.....90
DEALING FROM THE BOTTOM.....Inside back cover

FEATURES

LETTERS 2
GUILT IS GOOD FOR YOU—What's on Your Mind?.....45
HOW TO KEEP RACEHORSES IN THE RUNNING—Inventor of the Month..50
SAYING IT UNDERWATER—Inventions, Patents, Processes.....51
DIFFERENT YET THE SAME—Your Science ABC's.....78
THE WOMAN WHO STOPPED EATING—The Progress of Medicine 81
SCIENCE IN THE NEWS.....91

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SCIENCE DIGEST is published monthly by The Hearst Corporation, 959 Eighth Avenue, New York, N.Y., 10019. RICHARD E. BERLIN, *President;* GEORGE HEARST, *V-Pres.;* RICHARD E. DEEMS, *President of Magazines;* FRED LEWIS, *Executive V-Pres. of Magazines;* JOHN R. MILLER, *V-Pres. and Gen. Mgr. of Magazines;* G. HARRY CHAMBERLAINE, *V-Pres. for Research and Marketing;* WILLIAM S. CAMPBELL, *V-Pres. and Director of Circulation;* FRANK MASSI, *Treasurer;* R. F. McCAULEY, *Sec.*

ARE YOU MOVING . . . ?

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Second-class postage paid at New York, N. Y., and at additional mailing offices. Registered as second-class mail at the post office, Mexico, D. F., Mexico, June 20, 1950. Authorized as second-class mail by Post Office Department, Ottawa, and for payment of postage in cash. *Science Digest* is indexed in *Reader's Guide to Periodical Literature*. Printed in the U.S.A. Unsolicited manuscripts must be accompanied by a self-addressed and stamped envelope.

A dental objection

Your article "New Magic With Old Teeth" (Jan. '64) is shocking, especially because it is copyrighted by the American Dental Assn. It certainly indicates that dentistry is now a "cosmetic" service rather than a health service.

Mechanical treatment of a tooth, including removing the pulp, bleaching, etc., does not necessarily become a health measure. The tooth is only a product of the oral tissues of the mouth and, even after its removal, can leave a focus of infection. This is why so many people are suffering from referred pain, when these pleomorphic organisms are not recognized by bacteriological tests.

Why call it "science" when you only listen to outmoded techniques?

CHARLES T. PETERSON, D.D.S.
London, Ontario
Canada

At the last annual meeting of the American Dental Assn., endodontia

was made a recognized specialty of dentistry. I cannot agree that the treatment referred to in the article is an "outmoded technique."

PERRY J. SANDELL, Director
Bureau of Dental Health Education
American Dental Assn.
Chicago, Ill.

Updating the Patent Office

Here are a few late developments which will update my story "Crisis in the Patent Office" (March '64).

I stated the House had approved a $29 million Patent Office appropriation for the present fiscal year. The exact figure, as finally passed, is $29,225,000. I would also like to point out that David L. Ladd, Commissioner of Patents since 1961, has been succeeded by Edward J. Brenner, who was nominated by President Lyndon B. Johnson, Jan. 16, 1964. Finally, a bill to inaugurate maintenance fees for issued U.S. patents has passed the House, and at this writing is pending in the Senate.

STACY V. JONES
Falls Church, Va.

One-thirteenth of a ton

Excuse the tardiness of this letter, but regarding Neal Stanford's article "Last Days of the Panama Canal" (July '63), he says that the Canal authorities charged the one man "brash" enough to swim through the canal 45¢. Unless two men have done this, that statement is incorrect. The man I think Stanford meant was Richard Halliburton. He was charged, like every ship, by tonnage. He weighed one-thirteenth of a ton, and was therefore charged 36¢. It was the smallest fee ever paid for an interoceanic crossing in the history of the Canal.

ALAN I. KAPLAN
Bronx, N.Y.

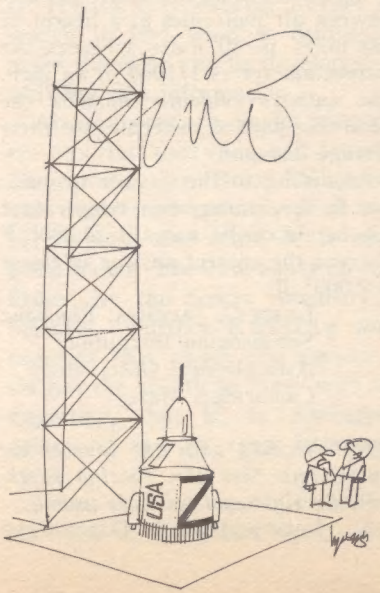
The Negro (cont.)

At reading the "Letters" in your Jan. '64 issue, I was appalled to see the bigotry that apparently still runs rampant throughout this land. I found the Oct. '63 issue and read the controversial articles on the Negro over again quite carefully. Although it does seem a bit strange that *Science Digest* would pick such a "hot" issue, it is not in the least out of bounds for the magazine.

Keep up your good work.

HENRY A. SEIGEL
Bristol, Penna.

" . . . I understand it was a budget cut."



I found your articles on the American Negro (Oct. '63) very interesting and informative, and I passed the issue along to many friends who were ignorant or ill advised. Don't let critics limit the scope of your scientific evaluations.

GEORGE BLACKMER
San Francisco, Calif.

If anyone has the idea that whites are better than Negroes, then it is time they went to Church and did some hard thinking and praying.

You cannot be a good Christian and still teach your children to hate their neighbor.

VICTOR PENCE
Springfield, Ohio

Gross errors

I was disappointed by two gross errors in the quiz "Air Your Knowledge" by John and Molly Daugherty (Jan. '64). According to the answer to question 4, the average distance between air molecules at a height of 250 miles is 40 miles whereas the correct answer is 1/1000 of an inch. The authors evidently mistook the mean free path of molecules for their average distance.

According to the answer to question 5, the atmospheric temperature at a height of 250 miles is 24,000° F whereas the correct answer is closer to 2,000° F.

LUIGI G. JACCHIA, Physicist
Smithsonian Institution
Astrophysical Observatory
Cambridge, Mass.

After checking with our sources we must admit that Mr. Jacchia is essentially right and we were wrong.
JOHN and MOLLY DAUGHERTY

Voluntary sterilization

Regarding your article on eugenics ("Science's Touchiest Subject," Nov. '63) and with the population explosion in mind—I would like to suggest voluntary sterilization of any woman who feels she has fulfilled her role to God when she has had three children. I am sure parents will agree three children can be properly cared for. Who can say definitely if any woman should have more?

MRS. RUTH BRISSETTE
Mukwonago, Wis.

Reading hieroglyphics

In your Dec. '63 issue you had a short entitled "A Walking Rosetta Stone" about a Nigerian who was able to "read" Egyptian hieroglyphic writing. Many signs in hieroglyphic writing are recognizable pictures. An American Indian, for example, familiar with the picture writing of his people, when shown some kind of hieroglyphic passage, no doubt could give it some kind of coherent interpretation, but it is extremely doubtful it would be the correct reading.

Hieroglyphics have been a dead language since about the fifth century A.D. It is a little difficult to believe that a tribe of nomads like the Tuaregs of Nigeria could have preserved a knowledge of such an abstruse subject for fifteen centuries. Of course, it is also possible that our Nigerian friend had studied the language, and was concealing the fact.

The Tuaregs are a people well-known to anthropology; if they have this knowledge, why was it not discovered before this?

M. BRAZILL
Landisburg, Pa.

The woman who tells color by touch

There is now evidence that at least a certain percentage of us can "see" through our skin.

by Robert K. Plumb

A MICHIGAN housewife has been found who can identify colors in the dark with her fingertips. Studies are now under way to see whether this mysterious ability is common throughout the population and whether it might eventually be used in helping the blind to read.

Dr. Richard P. Youtz, a psychology professor at Barnard College, has spent 60 hours testing the fingertip "sight" of the housewife. He believes that she has a mysterious ability that has not yet been explained by any known physical or physiological mechanism.

Dr. Youtz has extended his research by testing 135 Barnard psychology students to see if they can to some extent distinguish colors by their fingertips. Preliminary results suggest that some 5 to 15 percent of the Barnard students tested can do so. The National Institute of Mental Health is sponsoring further research to find whether devices to assist the blind can be developed by utilizing this information.

About a year ago, Soviet researchers reported that they had found a 22-year-old girl, Rosa Kuleshova, who could read ordinary print with her fingers. She could do it while blindfolded. The case has been confirmed by the Soviet Academy of Sciences. Further Russian work suggests that about one person in six has the ability to "see" with the fingertips, that is, to distinguish colors, if not to read letterpress type.

When the first reports from Russia came in, American experts were

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The class tried to identify objects by touch. Patricia Ainsworth could identify not only the shape but also the color.

highly skeptical. Most remain skeptical to this day.

Among the skeptics was Dr. Youtz. He was discussing the Soviet report with colleagues in the Barnard faculty lunchroom. All agreed that there could be nothing to it. Then Dr. Marion Gillim, a professor of economics, spoke up. She recalled an incident that occurred while she was teaching high school in Owensboro, Ky., in 1939.

A friend of Miss Gillim's, Mary Barret, was teaching health. They had a class try to identify common objects by feeling them while blindfolded. One girl, Patricia Ainsworth, was particularly good.

Miss Ainsworth, in fact, could identify not only the shape but also the color of the objects she handled.

Dr. Youtz got Professor Gillim to locate Patricia Ainsworth. She was found in Flint, Mich., where she is now Mrs. Ferrell Stanley.

Mrs. Stanley said that she could still identify colors with her fingers. Dr. Youtz went to Flint to work with her and since April has tested Mrs. Stanley for about 60 hours.

He employs a plywood box painted black inside and outside. It is light-tight. It is fitted with double-thickness black velveteen sleeves with elastic at the wrists for Mrs. Stanley's arms. Mrs. Stanley puts her hands into the box and identifies colors under various experimental conditions.

The experiments are designed to shed light upon the physical or physiological nature of her ability. So far, Dr. Youtz remains at a loss for an explanation. He has considered that it might be some chemical or electrostatic or photoelectric phenomenon. But the evidence gathered to date suggests that it is not chemical and neither of the other two theories is borne out.

Mrs. Stanley has to rub the colors with her fingertips for 30 seconds to two minutes to identify them. In some experiments she handles colored squares of cloth directly. In others, she rubs her fingers over plastic or glass coverings placed over colored paper. This is to rule out the possibility that she is identifying colors by some slight difference in texture.

Dr. Youtz described one of his most impressive experiments.

Fourteen pieces of cloth were put into the experimental box. There were two specimens each of red, yellow, green, blue, purple, black and white. The cloths were jumbled up on the floor of the box.

Mrs. Stanley put her hands through the sleeves. She mixed the cloth squares again and then proceeded to identify them.

This test was run three times, Dr.

Youtz said. It was conducted in a "double-blind" fashion so that neither Dr. Youtz nor Mrs. Stanley could see the squares before Mrs. Stanley identified them. Mrs. Stanley was not told whether she had a correct identification or not. In the first test, she identified correctly 11 out of 14 squares of cloth, in the next 13 out of 14, and in the third test she identified 12 out of 14 correctly.

The odds against such an identification by chance, Dr. Youtz calculates at several million to one. Her mistakes were in confusing yellow and white.

Mrs. Stanley cannot tell how she does it, Dr. Youtz said. Her report includes these words:

"The light colors are smoother or thinner or lighter in weight. The dark colors are thicker or rougher or heavier. Red, blue and green just feel like red, blue and green."

When colors are covered with glass Mrs. Stanley's ability to identify them is diminished if the glass is too thick. She can identify colors through glass three thousandths of an inch thick; she cannot do it if the glass is a sixteenth of an inch thick.

Temperature of the fingertips apparently plays a part, Dr. Youtz reported. When the specimens were cooled below 75°, Mrs. Stanley's ability to identify them dropped to no better than chance. And when her fingers and the samples were put in warm water (91°F.) her ability again disappeared.

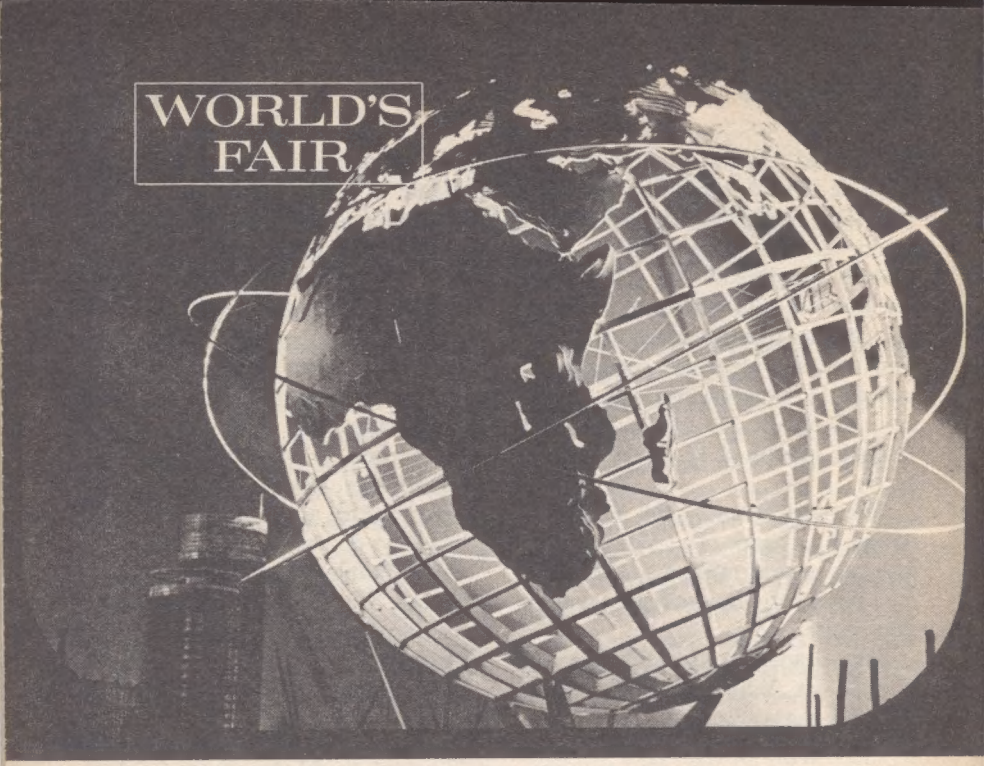
If the nature of the stimulus could be learned, then it might be possible to build equipment to produce and amplify the stimulus, and so help many blind people read.

Dr. Youtz has not tested Mrs. Stanley's skin other than the skin on her hands for the ability. She touches the color samples with fingers, thumb and both hands. One Soviet report had it that a subject had learned to identify colors—or to read, the report is not clear—after practice, and that another had learned to do so with her toes.

Mrs. Stanley is not able to read printing, Dr. Youtz's tests indicate. It is not known whether the color-distinguishing ability is related to color blindness. Mrs. Stanley has excellent color vision.

In the tests on Barnard students now being done, girls are given three plastic-covered color samples with their hands inside an experimental box. Two are the same color and a third is different. They are asked to pick the different color. The odds against doing this five times in a row by chance are 243 to 1. Some girls, Dr. Youtz said, have demonstrated some ability at this preliminary sort of tests. Girls with ability will be encouraged to practice.

EDITOR'S NOTE: Mrs. Stanley failed a recent series of tests given by Dr. Youtz. Her performance was only occasionally better than chance would allow. Dr. Youtz said, "We have an idea that it might be the cold and an idea that she might have stage fright—attempting to do this in front of strangers."



United States Steel's Unisphere is the symbol and centerpiece for the dazzling display of the World's Fair now being readied for its April 22 opening at Flushing Meadow, N.Y.

How to see it

by Hugh Downs

IF YOU can't go to the New York World's Fair, which opens this month, count yourself lucky.

A lot of people are going to go to the Fair this year—some 40 million, it's said. But a whole lot more Americans aren't going to be able to go. If you're one of them, this article is for you.

You're lucky because the almost fantastic technological advances of our age—which is what the World's Fair is all about—make it possible for you to see just about everything there is to see *without going*.

I mean that television is going to bring the Fair to you. It's going to take you on aerial rides high above the Fair, transport you through space and below the sea, show you bursting suns and artificial larynxes, send you on a 'round-the-world cruise, reveal the secrets of computers, dazzle you with auto thrill and water shows, unveil the way we'll live tomorrow and treat you to almost unlimited admission to the greatest show men have ever put together anywhere.

By far the most extensive cover-

TV's Hugh Downs, right, and his staff will host the most extensive coverage of the Fair opening, and events there through the season, on NBC's daily morning show TODAY.

without going

age, I'm happy to report, will come to you via NBC's daily morning show *Today*, of which I'm master of ceremonies. The entire two-hour show on Thursday, April 23, the morning after the opening, will be devoted to the Fair. From 7 to 9 a.m., in each time zone across the country, we'll bring you a review of the opening ceremonies and a panoramic introduction to the Fair as a whole. On Friday of each succeeding week from 8:30 to 9 a.m. (7:30 to 8, in the Middle West), we'll bring you a half-hour segment showing you particular exhibits and shows of current interest. *(For other TV coverage, see page 10*—ED.)

We'll have a special unit working at the Fair full time throughout the spring and summer to put together this coverage. It'll include a director, writer, cameraman, researchers. At times, we'll have 20 to 30 people in all working on Fair coverage. Where we can't operate television cameras, we'll use film cameras.

The April 23 show has been planned to open with a half hour of tape shot at the main entrance to the Fair as the first crowds pour in to behold the 600 wondrous acres of

science and showmanship. They'll be followed by other crowds day after day until October 18, when the Fair will close for the winter, reopening the following April.

The second half hour, from 7:30 to 8 a.m., we'll be in the Industrial Area, with an account of the elaborate opening-day ceremonies.

From 8 to 8:30 a.m., you'll see an unusual record of the unbelievably complex, eye-popping planning and work that made this Fair possible. It's a montage of films showing the emerging shapes of the fantastic buildings as they rose on Flushing Meadow over the past year. Then we'll take you on a quick trip of the pavilions as they stand now.

The final half hour of that April 23 *Today* program will show you what probably will be the most dazzling fireworks display ever staged as seen on opening night.

Maybe what we'll have to show you of the Fair in the weeks that follow will seem like a come-down after that. But consider the grab-bag into which we'll be dipping.

Consider the world of tomorrow that unfolds in General Motors' Futurama. (See *"Will This Be the No. 1 Show?"* which follows.—ED.) Then there's Ford's Magic Skyway trip from caveman to city dweller, and Chrysler's engine, built big enough for you to walk through.

The Hall of Science has space ships that actually rendezvous. RCA offers an attraction to bring out the ham in everyone—color television cameras trained on the visitors themselves. General Electric tells the story of electricity on "stages" to

How TV will cover the Fair

The Ed Sullivan Show (CBS, Sundays, 8 p.m. in each time zone) will broadcast a Fair program in advance of the opening.

An NBC-TV 90-minute color program will cover the Fair's opening night April 22 from 7:30 to 9 p.m., EST.

The *Today* show (NBC) broadcasts a two-hour special program on the Fair April 23 from 7 to 9 a.m. in each time zone. A weekly half hour segment on the Fair will be broadcast on Friday of each succeeding week throughout the spring and summer from 8:30 to 9 a.m. in each time zone (7:30 to 8 a.m. in the Middle West).

What you'll see

which the entire *audience* revolves. DuPont displays today's chemical marvels, which bring to mind the marvel of nylon that it unveiled in 1939, at the time of the first New York World's Fair. (See story, *"What's New and What Isn't,"* which follows.—ED.)

IBM shows how Russian can be translated instantaneously into English. National Cash Register teases your feeling for numbers with a Machine Game Room. For a look at the homes many of us may some day be living in, if we're fortunate, there's the Formica World's Fair House. For women only, Clairol dreams up new shapes and colors of hair. And for the statistical-minded, Equitable Life displays a 45-foot map recording each birth and death in the U.S.—an exhibit intended to impress you with how many of us there are. It does.

I can't even begin to list the foreign exhibits, but a couple of them are such huge, real replicas of the countries they represent, you can almost feel that you're actually there. Japan's exhibit, for example, includes a castle and, within the main pavilion, a Japanese garden. And Belgium has a town consisting of 17 streets and 124 houses.

The Federal and state exhibits take you to almost every corner of our great land. The stand-out is the New York State exhibit. The pavilion consists of pillars holding a cup-shaped roof; three towers stand alongside, the tallest 200 feet high.

The New York State pavillion

The General Electric pavillion

The Belgian Village

Then there's the New York City exhibit, which includes a scale model of all five boroughs showing each one of the city's 840,000 buildings.

If that doesn't impress you, let me try one more:

It's the electric utilities show, called the Tower of Light. This consists of vertically staggered prisms which rise up to 80 feet high from a reflecting pool, from the middle of which rise three prismatic pylons 120 feet high, and topping off that are the beams from 12 searchlights which send up shafts of light equal in brilliance to 340,000 automobile headlights.

It's calculated that the display will be visible from as far away as Washington, D.C., 205 miles away.

If you're not going to the Fair but you still want to see it, if you live up to 205 miles away, you won't need even a TV set.

The beam from the Tower of Light will be visible from as far away as Washington, D.C.

Exterior of the pavilion that will house the spectacular G.M. Futurama ride.

Will this be the No. 1 show?

The General Motors Futurama ride was the most popular attraction of the 1939 Fair. This time G.M. is presenting another Futurama which promises an even more spectacular look at things to come. Here is what you will see.

THE unending night of deepest space broods everywhere, gives way for a moment as a multicolored map of the earth appears, then darkness covers all again.

The darkness eases and the craggy surface of the moon appears close at hand illumined by a spectral half-light. Traveling three abreast in contoured lounge chairs, you watch manned lunar crawlers make their tortuous way over the pitted floor of a canyon or up the side of a crater. Vehicles, unlike anything seen on earth, transport men and equipment on their exploratory travels. Nearby, a control station watches over a cluster of spaceships poised for launching.

Now the moon disappears and utter darkness returns. Suddenly a space station, surrounded by small rocket vehicles hovering to land, orbits silently past. The station serves as a way stop between the moon and the planet earth which has appeared suspended at a great distance.

The earth, its Southern Hemisphere in view, draws closer, then disappears in the myriad hues of an aurora. Through the aurora an

1 The craggy surface of the moon will be traversed by a weird variety of manned lunar vehicles, unlike anything ever seen on the face of the earth.

Antarctic vista appears, a windswept, ice-studded, snow-covered plain that reaches to a distant ice shelf at the ocean's edge.

Cut into the ice-shelf adjacent to the land mass that forms the Antarctic continent is an all-weather port. The harbor is in the shape of a tube several hundred feet in diameter sunk through the ice shelf into the unfrozen sea and anchored to the land.

The water within is kept from freezing to allow atom-powered submarine trains, sailing beneath the ice shelf, to surface within the harbor to discharge their cargo. During the savage Antarctic winter, when the shelf extends far into the sea, the sub-trains can unload directly onto the land mass and save heavily-laden transporters the necessity of long and sometimes dangerous trips over the shelf.

The area around the port serves as a staging point for supplies coming into Antarctica. Cargo containers are being unloaded from VTO (verticle take-off) airplanes and loaded onto multi-wheeled, multi-purpose, over-ice haulers.

The transports roll inland over the wind-ravaged plain which lies at the foot of towering mountains whose snow-covered flanks sparkle in the sun. The vehicles head for a weather study base which is under construction. Smaller versions of the over-ice haulers, personnel carriers and other vehicles move busily amid a group of individual modular structures pre-fabricated of plastics and specially insulated to withstand the sub-zero temperatures.

Legs raise the buildings above the surface so that snow, driven by the incessant winds, will not pile against the structure but pass beneath it.

Rockets, used to acquire weather data from the substratosphere, rise alongside their control station. Dotting the surface are unmanned weather units reporting automatically via radio and television.

2 Penguins will still roam the frozen wastes of the Antarctic, but man will live there too. In the background are specially insulated plastic structures.

Through shimmering, ice-reflected shafts of light you are taken beneath the surface. The interior of a room appears and a man is seen scanning a dimensional radar screen. Near him stands an animated map upon which is recorded the temperature, speed-of-flow and salinity of the water that surrounds the continent.

Another man, in visual contact via television with the space station which appeared earlier, is seen. Upon a map of the world, the paths of space, land and sea weather-reporting vehicles are traced in colored lights; other lights mark the locations of stationary weather reporting units.

The room is part of a global network of weather forecasting stations. Here are collected climatic reports from land, sea and air which are fed into computers.

The headquarters is located in the Antarctic because it is here that most of the Southern Hemisphere weather originates. It in turn affects, to a marked degree, much of the weather of the Northern Hemisphere.

The scene moves into an ice cavern, then—as the light changes from glittering, white-washed blue to rippling, dappled green—down into the sea at the edge of the ice shelf. The sunken wreckage of a three-masted whaling ship comes into view.

An aquacopter, a two-man undersea personnel carrier fitted with claw-handed arms and capable of operating at depths up to 10,000 feet, appears as the occupants inspect an ocean-floor lode of manganese nodules. An atom-powered submarine train passes and heads for the all-weather port on the shore of Antarctica.

An undersea recreational area comes into view. Resort hotels, free-floating or secured to the ocean floor, are at depths from 50 to 200 feet. Through over-sized windows

3 Man's domain will extend to the bottom of the sea which will be used for mining, farming and as a vast recreational area, with underwater hotels.

vacationers may be seen dancing, eating dinner. Others are renting underwater camera or fishing equipment before donning breathing-apparatus for an excursion into the surrounding waters.

Small vehicles, similar to the aquacopter and driven by sportsmen, pass through groups of open and closed diving bells used for photography and fishing. A swimmer is towed by an aquascooter past a port at which a number of undersea vehicles are docked. With some three-fourths of the earth's surface covered by water, vehicles of these and other types provide the mobility necessary to harvest the food and tap the natural resources that lie beneath the sea.

The light brightens from the chill, dark green of the ocean depths to the sun-warmed, lighter hues of the shallows. Coral and sand give way to seaweed, grasses and the roots of trees. The verdant, steaming jungle —the "green hell"—emerges. The sounds of birds and animals come through the otherwise impenetrable growth. A stagnant, insect-laden pool holds shreds of rolling mist.

A "crack" sounds above the jungle noise. A towering hardwood is lowered to the ground in the arms of a tree cutter that uses a laser beam as a saw blade.

In the wake of the cutter comes a road-building vehicle as high as a five-story building and as long as three football fields. The head end

of the road-builder partially levels the ground cleared by the cutter, the following section sets double rows of steel pilings. A third section casts rectangular slabs composed of cement, plastics and other materials. The slabs are placed end-to-end atop the pilings and secured. Thus, as the vehicle moves forward, a divided, multi-laned highway is laid in its path. Also visible are mobile homes designed for the tropical climate.

The completed highway is seen carrying cars and trucks through the jungle to a community which functions as a transportation center for products gleaned from jungle clearings—lumber, chemicals, farm crops and other commodities. An elevated pavement installed to meet man's needs has replaced the meandering river as the highway of the jungle.

Beyond the jungle community the view climbs to a plateau, then scales sheer rock rises until a mountain, pierced by a tunnel carrying the highway up from the lowlands, is seen. On the leeward side of the mountain, as the prevailing winds blow, a vast, arid land appears. The expanse is broken, however, by a patchwork of colors formed by corn, wheat, soybeans, potatoes and other crops. They thrive in the mineral-rich desert soil of this farm through the grace of water raised from subterranean rivers or desalted sea water piped over the mountains.

The farmer employs highly sophisticated techniques and equipment which he controls from an elevated "farm house" at the edge

Climax of the Futurama will be a view of the city of the future at night—"the mark of man on God's landscape."

of the fields. Here fertilizers are mixed with the life-giving water whose flow to the fields is automatically regulated by moisture-sensing devices planted midst the crops.

The land rises beyond the farm and a suburban living area appears in the distance. The highway emerges from a mountain tunnel, bridges a gorge and disappears into a tunnel that pierces the neighboring bluff. Projecting from the bluff is a home. Circular in shape, it is built on four levels.

The highway reappears beyond the home and becomes a multi-laned landway as it nears a major metropolis. Some of its lanes, part of an intercontinental express highway, speed cars and trucks around all cities. Other lanes carry city-bound vehicles. Still other lanes are reserved for trucks headed for a highly-specialized freight center which serves an industrial complex that adjoins the city.

In the background is a bargeway which carries water-borne freight to the center. Rising in the midst of the industrial area, the center is marked by special containers for the storage of liquids, bulk commodities and other materials.

As the landway nears the city, wheeled bus-trains speed along on specifically-designated lanes. At non-peak commuter hours, these lanes are used as express freightways. Additional lanes are color-

4 Living space will be carved out of the "green hell" of the jungle.

5 The farm of the future will not look like anything we now know.

coded according to their destination; traffic on other lanes is electronically routed, guided, speed-controlled and braked by control stations located on the perimeter of the city.

The landway leads into an inner-city living area which is marked by high-rise apartment buildings with interior parking accommodations and modernistic, row-type houses constructed at varying levels. Shops and service centers situated on the lowest levels and strategically-located parks and recreation plazas make the living area a self-contained unit whose functional beauty is in sharp contrast with most residential areas existing today.

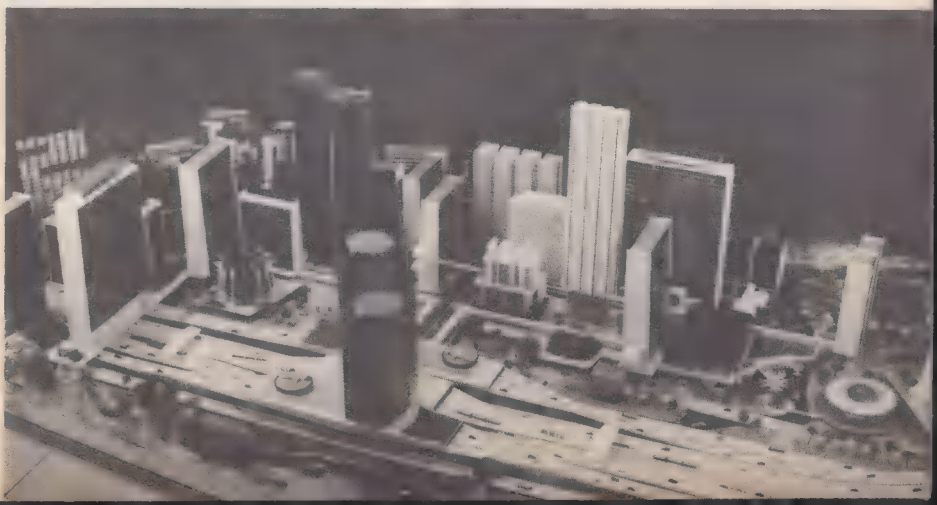
The landway leads into the city proper whose most dominant structure is the transportation center. It is located above the landway and utilizes—as do many of the structures in the living area—air rights which remain unused over most major urban traffic arteries of today.

The transportation center serves as a terminus for commuter bus trains, individual passenger vehicles and VTO airplanes. The center provides automatic, high-speed automobile parking for downtown visitors and for travelers bound out of the city by VTO link to airline terminals located on the periphery of the city. Moving sidewalks serve the transportation centers and adjacent buildings.

The transportation center, and other similar installations located about the city, are linked to the landway control system which directs motorists to parking areas.

Past the city—the product of today's most advanced thinking—the land rises and darkness returns. Suddenly, far below, appear the city's lights—the brilliance that brightens a great modern metropolis at night, "the mark of man on God's landscape."

6 In tomorrow's city, many buildings will rise atop urban traffic arteries. All traffic will be controlled from a main transportation center.



WORLD'S FAIR

What's new and what isn't

The scientific marvels that will go on display at the New York World's Fair this month far outstrip anything that could have been predicted 25 years ago. But the progress reflects, not so much what science has discovered, as what technology has exploited.

by Bruce H. Frisch

TWENTY-FIVE years ago, on the site of the 1964-65 New York World's Fair, there opened the '39-40 World's Fair, dedicated to the World of Tomorrow.

Now that tomorrow is today, and many of the predictions then made have come true. But none of the forecasters came close to the world on view at the new Fair.

For the world in 1939 was on the brink of a scientific revolution in which science was exploited for practical ends as never before. And the then thrilling pace of technology, recorded in a capsule buried on the Fair grounds, now seems as creaky as an oxcart.

It was the year that women went wild over the first experimental sale of nylons. On Oct. 24, customers were lined up three deep at six Wilmington, Del., stores. Supplies ran out by one in the afternoon. More were rushed into town from DuPont until 4,000 pairs had been sold. But nylon had a history typical of the period. It was the product of the industrial lab, where much of science had moved from the university after Thomas Edison set up his "invention factory" at Menlo Park, N.J., in 1876. Test-tube quantities of nylon were made seven years after research began. It took five more years to get it on the market.

It was the same with television. The opening of the 1939-40 Fair was televised in pale green and the sale of TV sets begun simultaneously. But by the end of the year, it

A time capsule filled with information predictions for the future hung suspended above the '39-'40 Fair grounds for two years. It was then sunk into the ground. Today's Fair, rising above the spot the old capsule is buried, will show that many of the '39 predictions are already dated.

was plain that the push was just another of the many false starts since G.E. first broadcast TV at Schenectady in 1928.

The world was sitting on a mountain of other unexploited scientific research.

More than twenty years of research by Dr. Robert H. Goddard, the American rocket pioneer, was being neglected as Goddard scraped along on the small grants the Smithsonian Institution and the Guggenheim Foundation could afford. Rockets were not forgotten. Chrysler had a Rocketport Theatre at the Fair where a movie on the history of transportation was climaxed by the simulated launching of a model rocket. However, the world was generally ignorant of the real work being done by Goddard, and by the Russians and the Germans at Peenemunde. A prominent scientist making a forecast on the occasion of the Fair wrote that, even with oxygen and hydrogen (now considered super fuels and used to boost Centaur), it would be impossible to escape the earth; we would have to wait until we could duplicate the fusion energy of the sun.

He, of course, couldn't know that the new scientific revolution was about to start with the outbreak of World War II. The Government began to mine the backlog of research for the weapons and shields of war. It began force-feeding science with that magic hormone, money, until it grew into the giant, Big Science, we know today.

Goddard had to start right where

he left off in WWI. The U.S. military had hardly given rockets a thought in the intervening 20 years. In fact, we required liberal transfusions of knowledge from the British to get us going. We were the last of the big powers to tackle rocket development. By the end of the war, Goddard and other rocketeers had designed bazookas, air-to-ground bombardment rockets and antisubmarine rockets.

Other wartime labs turned out radar, the proximity fuse, the loran radio navigation system and the two-billion-dollar atomic bomb.

While the '39 Fair buildings were still going up, two German chemists in a Berlin suburb had discovered atomic fission. On January 26, 1939, physicists here were startled to learn of it from the visiting Nils Bohr at a Washington scientific meeting. They rushed to their labs or to their phones to spur friends back home into action. But the night before, having gotten advance word, John R. Dunning at Columbia University had carried out the first confirming experiment in the U.S. By summer, the Government had taken the first small step toward the A-bomb.

Fission energy, unforeseen, has now long been harnessed, while the control of fusion energy, so freely predicted 25 years ago, has just begun. G.E. will demonstrate controlled sun-power on a laboratory scale at this Fair.

Immediately after the war, the Government cut back its science spending, but Korea boosted it back

up again. Then in 1950 there were more slashes, only to have Sputnik send outlays into orbit. Research and development financing has almost quintupled in the last decade.

Thus the wartime entry of government into science became a permanent way of life, and with it the forced-draft exploitation of science. Whole industries turned to selling innovation. They had to bring out something new every year. In a report he prepared for UNESCO, Pierre Auger noted that while 50 years ago it might have taken about ten years to move from the discovery of a new phenomenon to its practical application, it now may take as short a time as a few months.

The original wartime flood of devices spelled great scientific strides

We think of TV as a "modern marvel," yet F.D.R. was televised as he opened the '39 Fair (above). TV is "modern" only because its widespread use is recent.

for the general public, when in reality, as measured by the number of scientific papers published, WWII like all wars had slowed progress. What had happened was that past progress had been intensively developed into practical devices.

Likewise, the seeming spurt since the war is a mirage. Science has expanded to be sure, but no faster than it had for the previous three centuries, doubling in size and output about every 10 to 15 years. The cycle from discovery to market place has accelerated, but not the rate of growth of science. As an example, it has been estimated that there are 500 companies working on the laser. At least three of these, G.M., Ford and G.E., will display their progress at the Fair.

Along with science has grown its volume of literature. Today, as at any given time in the last 300 years, as much has been published in the preceding ten years as in all previous time. By now, this volume of literature has reached unmanageable proportions. In the second year of the '64-'65 Fair, about one million different scientific papers will pile up on library shelves. Scientists can't keep up, especially those in applied science. They often find themselves repeating someone else's work. An engineer at DuPont says, "We found we were redesigning the wheel six times a week." But to do a thorough search of the literature costs so much that an executive of a large steel company estimated that if an experiment costs less than $100,000 to perform,

it is cheaper to do it yourself than try to find out if it has been done before. To cope with this problem, information retrieval equipment is being developed which stores references in compact form, and searches for, retrieves and reproduces items automatically. A granddaddy to many is the microfilm idea exhibited by Kodak at the '39 Fair. With microfilm it was possible to cram the '39 time capsule with ten million words on three and a half reels of film. Today's information retrieval systems sometimes rephotograph from microfilm to crowd 10,000 pages on a 10- by 10-inch sheet of film. A junior IR system will be on display at Kodak as the science library of the future.

Science historians feel the exponential growth of science has not much longer to run in the U.S. Yale professor Derek J. Price thinks our expansion may have already started slowing down. Former State Department science advisor Dr. Wallace R. Brode figures the past rate of growth won't continue beyond 1970. Since U.S. science will no longer be able to grow by adding more scientists, says Dr. Brode, we will then have to expand by raising the quality of scientific education rather than its quantity.

One of the most recent schemes for remaking the schools is to use programmed instruction in teaching machines. Thirty-seven years ago, Professor Sidney Pressey of Ohio State U. built a machine with the basic modern features. It went unnoticed. It was re-invented in 1954 by the Harvard professor, B. F. Skinner, as an outgrowth of his work training animals in a psychology lab. Some of the machines and programs that have since sprouted will be included in the Hall of Education.

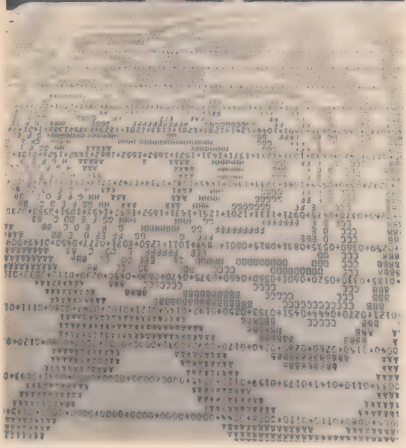
Coinciding with the slowdown in expansion of science in Europe and the U.S. will be the entrance of developing countries into the scientific world. Overall, the world rate of growth probably won't slacken. But science may trend toward the practical, because, Professor Auger pointed out in his UNESCO study, new countries devote themselves almost entirely to applied science.

Anyway, applied research is king at the 1964-65 Fair, because exhibitors are there to push the saleable results of research.

If applied research is king, entertainment technology is queen. From the Ferris wheel to Futurama, this world's fair, as world's fairs always have done, will display the latest in showmanship.

The razzmatazz will make it difficult to measure the progress we'll see at Flushing Meadow starting April 22. Yet what H. G. Wells said before the opening of the '39 Fair still holds true:

"The visitor who wants to get the most out of this World's Fair will do best to regard it not as a show of things but as a collection of hints and let his imagination off the leash of discretion a bit. . . . Then he may really get a glimpse of the realities of tomorrow that lurk in this jungle of exhibits."

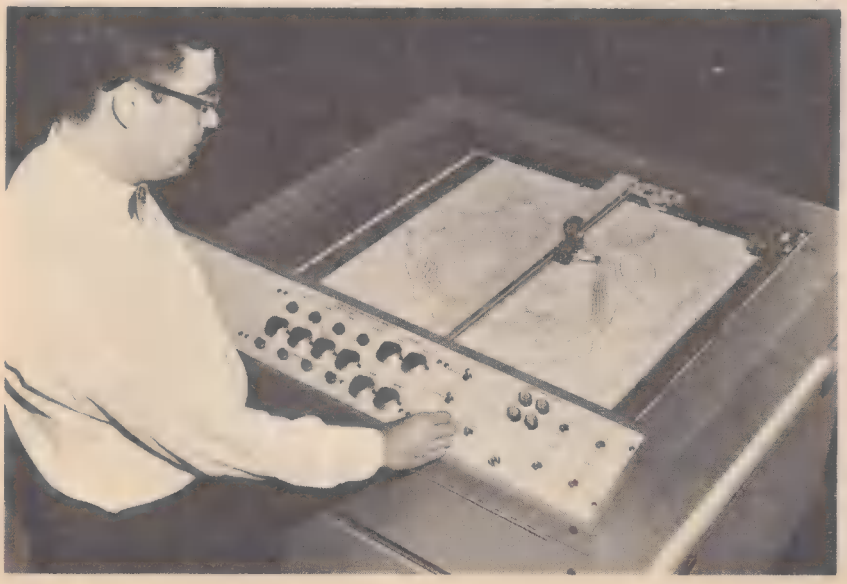


Needed— umbrella weather forecasting

Armed with weather satellites and high speed computers, modern meteorologists still can't tell you for sure if it will rain in your town today. For the story, turn the page. ➔

Computers like the IBM STRETCH (left) can construct a "model" atmosphere.

The computer plotter (below) can draw weather maps from data on magnetic tape.



Computers can analyze weather changes in the upper atmosphere—but, as of now, that means little in preparing the daily forecasts.

by Robert C. Cowen

ANYONE brought up in the old-fashioned school of weather forecasting must look on present-day meteorology as an ironic miracle. The science of weather prediction is now so accurate that it can provide valuable forecasts for whole continents; it still cannot tell you with any satisfactory assurance when to take your umbrella to work in the morning.

The technology that has brought the Tiros satellites and a generally new scientific approach to forecasting represents a potential rather than an achievement. It opens the possibility that the atmosphere can be studied on a scale and in a manner that could establish major gains, both in pure knowledge and in practical forecasting.

This is the challenge that confronts the new chief of the United States Weather Bureau, Dr. Robert M. White, as he settles into the office he assumed last September.

To understand the challenge more fully, one should take a short look back to where practical meteorology stood not long ago. A forecaster then worked (he often still works) to the background clatter of teleprinters pounding out rows of numbers and the special weather symbols received from stations of the observing network. With neat hand lettering, technicians plotted these data on base maps. They drew in isobars, warm and cold fronts and the other abstractions that represent the reality of wind and rain, of storm and sunny skies. Then, by a combination of guesswork and rule of thumb, they decided how the map probably would change during the next twelve or twenty-four hours and issued the forecast.

Theory meant little

Textbook theory played a relatively small role in this work. The atmosphere is too complex, too rapidly variable, to be handled with mathematical precision by the means at that time available. Then came the electronic computer, and the theorists at last had a machine that could keep pace with their data.

During the 1950s, Professor Jule G. Charney of M.I.T., Lt. Col. Philip D. Thompson of the Air Force Cambridge Research Laboratories, Dr. George Cressman of the Weather Bureau and other meteorologists worked at translating the

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New chief of the U.S. Weather Bureau, Dr. Robert M. White, faces a major challenge.

classical laws of physics as they govern the atmosphere into a form that computers could handle.

These early mathematical models were so crude that they neglected such important factors as heating and cooling, clouds and precipitation. Confined to parts of the Northern Hemisphere outside of the tropics, they scarcely seemed to represent the real atmosphere at all. Yet they have proved valuable enough to be used in forecasting today.

At the Weather Bureau's National Meteorological Center (NMC) at Suitland, Md., data are received on punched paper tape that is fed directly to the computer. The machine studies information, prints out for human appraisal any that seems ambiguous, and prepares for itself a symbolic equivalent of a map of current weather, which is then projected ahead to form the forecast. This forecast, recorded on magnetic tape, can in turn be fed to a drawing machine that traces out a map in three minutes.

The forecasts that come directly from the computer deal with patterns of pressure and winds in the upper air; they are especially valuable for jet aircraft. Other machine analysis, sea-level extrapolations from the upper-air predictions, are given to human forecasters as a guide. However, Dr. Cressman, who now heads the NMC, says that it is only a matter of time before sea-level forecasts will also come directly from the computer.

One must remember that the products of Suitland serve other forecasters, not the general public. They are nation-wide or hemispheric maps that go to regional centers where it takes judgment and experience to relate their large-scale features to the localized weather that interests you and me.

This local forecasting has yet to show any real improvement from the success of the new meteorology. It may never be really perfected, because perfection could require an observing network so elaborate that its cost would be prohibitive. But between the present state of local forecasting and the economic point of diminishing returns lies a large area for improvement that has hardly begun to be explored.

Perhaps some kind of statistical system can be evolved that uses a formula of probabilities in the absence of the most minute data. Perhaps key factors that link local weather to the larger features of the Suitland maps will be found. But whatever the road to improving local and general forecasting, it will be discovered through the new un-

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Robert C. Cowen is natural science editor *of The Christian Science Monitor.*

Meteorologists must break out of their shells and carry their case to the public if they are ever to make use of their new opportunities.

derstanding of atmospheric processes that mathematical modeling has brought within the meteorologist's grasp.

Professor Jule Charney foresees that in another five years improved models submitted to a new generation of high-speed computers will enable one to simulate the atmosphere with a high degree of realism. But such capabilities, he says, would overwhelm the present weather-observing system. This, essentially, is a complex of 120 national networks, spotted for the most part over land areas of the Northern Hemisphere; its coverage of the tropics and the oceans is poor. If meteorology is to make the major advances of which it now is capable, the need for a truly global observing system will soon be imperative.

New observing stations needed

The World Meteorological Organization (WMO) is already exploring ways to meet this need. Professor Charney, who is involved in the planning, says that, as an immediate step, WMO proposes to establish fifty-three new observing stations, mainly on ships and islands, to fill some of the oceanic gaps. However, some 600 new stations will be needed to provide even marginally acceptable world coverage.

Such a system could be substantially augmented by weather satellites. Instruments are now being developed that should enable a satellite to use heat and other radiation to measure the distribution of temperature, moisture and certain gases like ozone that absorb heat. The satellites could also pick up and transmit data from unmanned land stations, instrumented ocean buoys and balloons.

A study by the National Aeronautics and Space Administration indicates that balloons can be floated at predetermined heights in the upper air. They could be made so fragile as to be no hazard to aircraft. Their instruments, batteries and radios would be thin films on their outside skin, a form made possible by miniaturized electronics.

While the United States can contribute strongly to a global observing system, especially in the satellite field, it cannot establish such a system alone. "Neither we nor the advanced nations by themselves are going to do this job," says Dr. Thomas Malone, president of the American Geophysical Union. "It requires upgrading meteorological skills all over the world."

It is at this strategic moment in

the development of meteorology that Dr. White has taken over the Weather Bureau. With a doctorate from MIT, and with research and administrative experience at the Air Force Cambridge Research Laboratories, and more recently as president of the Travelers Research Center, he is one of the leaders in developing the new meteorology.

Air pollution warnings

As head of an agency charged with serving the public, he is aware that he has to make maximum use of the tools and knowledge already in hand. He says he is studying all Weather Bureau services to see how they could be improved immediately. Computers, potentially, could turn out new weather maps every hour. Would this be useful? Would it be helpful to give people an estimate of uncertainties in forecasts, perhaps by stating the percentage probability of rain and so forth? Should air pollution warnings, now given for certain cities, be made a nation-wide service?

Beyond such decisions, though, Dr. White knows that any really important advances in the services of his bureau depend on advancement of meteorology itself. The Weather Bureau, he says, "must view all technological developments and find out what we can use. We must be in the forefront of all relevant technology. . . ."

These are brave words, and it is no reflection on Dr. White's abilities to say that it may take a Herculean effort to live up to them. The Weather Bureau has many outstanding workers who are indeed in the forefront of their specialties. But as an organization it also has a record of resistance to the unorthodox.

But it is unfair to single out the Weather Bureau for criticism. It reflects an attitude widespread in the American meteorological field. Again, the fault does not lie entirely with the meteorologists. For many years, other scientists have treated meteorology with indifference, if not scorn.

If meteorologists are to carry their science into the new era now opening before them, they will need enlarged public understanding and support from a Congress that has grown suspicious of the continuing rise in government research spending. To gain this understanding and win this support, meteorologists must break out of their shells and carry their case to the public. Otherwise, the revolution that promises so much may lose its momentum.

★ ★ ★ ★

ARTIFICIAL lighting, such as with fluorescent tubes, can be harmful to living cells, says Dr. Marinus Dijkman, professor of tropical botany at the University of Miami. Working under a National Institutes of Health grant, Dr. Dijkman is conducting a study to determine the effects of artificial lighting in everyday life. Fluorescent lights give off ultraviolet rays. A 1951 experiment indicated that such rays might cause tumors.

FLUORIDATION FIGHT IN N. Y.

The government of America's largest city has decided to fluoridate its water. But resistance to the move continues, much of it centered around a new report from Canada—on possible side effects. Here is the story of the city's decision, followed by an account of the Canadian report.

Why the city decided to act

by Howard A. Rusk, M.D.
Associate Editor of The New York Times

NEW YORK CITY will finally fluoridate its water supply.

The decision came in mid-December, when the Board of Estimate voted on a proposal to amend the city's budget to appropriate $565,000 to construct nine fluoridation plants and $798,000 for their initial operation and maintenance.

The active campaigning for fluoridation in New York City began in 1952 when fluoridation was recommended by the Board of Health. Public hearings were held in 1957, but no vote was taken by the Board of Estimate.

In December, 1962, a group headed by Dr. Luther L. Terry, Surgeon General of the United States Public Health Service, met with Mayor Wagner to urge action on fluoridation.

Last April, *The Journal of the American Dental Association* accused Mayor Wagner editorially of ducking the fluoridation issue because it was too controversial politically.

The Mayor immediately stated that as soon as action was finished on the city's budget, the Board of Estimate and the City Council would take up the issue.

They did so in November at a public hearing.

Among those testifying was Surgeon General Terry, who endorsed the proposal "without reservation."

The Public Health Service, he said, "urges every community to make the benefits of fluoridation available to its citizens as soon as possible."

All major health organizations both nationally and locally favor fluoridation. The proposal is also favored in New York by various unions, the Citizens Budget Committee, Community Council of Greater New York and the Women's City Club.

The values of fluoridation have been proved and reproved in the last 18 years since the first controlled scientific studies on fluoridation began. These findings have been reconfirmed under two recent studies.

Ten years of fluoridation in New Britain, Conn., reduced tooth decay an average of 45 percent in children. Reductions range from 64 percent for 6-year-olds to 40 percent in 16-year-olds.

In Pittsburgh, tooth decay among school children after nine years of fluoridation has been reduced to

Reprinted with permission from *The New York Times*. ©1963 The New York Times.

Tooth decay is the most common physical defect among school children. Despite this, one half of all the nation's children under 15 years of age have never been to a dentist.

about the same degree as in New Britain.

[In the United States and Canada, more than 1,200 cities have fluoridated their water. Of 103 communities that began fluoridation and then dropped it, 30 have reinstated the practice.—ED.]

The American Medical Association's support of fluoridation dates to 1951 with a comprehensive statement adopted in 1957.

In November, 1963, in its Journal, the American Medical Association reaffirmed its endorsement.

In a study of child health released in December by the Children's Bureau, Department of Health, Education and Welfare, tooth decay was reported to be the most common physical defect among school children.

Despite this, one half of all the nation's children under 15 years of age have never been to a dentist, and of the remaining one half a sizable portion are not receiving adequate dental care.

There is no evidence of any ill effects from properly controlled fluoridation. When levels are too high, there may be some discoloration of the teeth. This does not happen, however, at the level of fluoridation used in public water supplies.

More than seven million Americans live in communities where the public water supply is naturally fluoridated. One such community is Bartlett, Tex., which has eight parts of fluoride per million. A 10-year study has shown no differences in the medical history of its residents compared with those of Cameron, Tex., which has just a trace of fluoride in its water.

The study group, exposed to Bartlett's water for an average of 36.7 years, showed signs of staining of teeth as a result of the high fluoride content of the water, which was eight times greater than the recommended public health level of one part per million. In 1952 Bartlett started defluoridating its water to a content of about 1.2 parts per million.

An interesting sidelight of the Bartlett study was the absence of pathological hip fractures so common in the elderly.

[Dr. Frederick J. Stare of the Harvard School of Public Health, as reported in *Science Digest* September, 1963, says fluorides influence the deposit of calcium in the bones, helping retard a senile condition in which the bones become brittle and break easily. ED.]

The economic value of fluorida-

tion in New York was pointed out last May by Dr. Arthur Bushel, director of the Bureau of Dentistry of the City Department of Health. He estimated that 38 percent of the city's children in the 14-to-16-year-old group, 382,000 children, get no dental treatment at all, and 12 percent get only "token treatment."

The Department of Health spends about $2.25 million a year for clinical dental services for children.

If New York had not fluoridated its water those expenditures would have had to be increased greatly.

Many New Yorkers who are truly concerned with improved health services for the city's children welcome the leadership of Mayor Wagner, Council President Paul R. Screvane and the members of the Board of Estimate and the City Council in favor of fluoridation. It is an action that is long overdue.

The story of fluoridation

The discovery that fluoride prevents tooth decay came as the result of life-long studies by Dr. Frederick S. McKay, a Colorado Springs, Colo., dentist, to track down the cause of tooth-mottling. This discoloration was finally traced to a high fluoride content in the drinking water. Along with the tooth mottling it was also found that people in localities with high fluoride content had far fewer cavities. Further studies showed that small amounts of fluoride could reduce cavities without causing mottling.

In 1959, the journal *Nutrition Reviews* reported on a large number of comparative studies. The general state of health of individuals who had lived for many years in regions where the water was naturally fluoridated compared favorably with that of persons whose water supply was low in fluorides.

"These data," the journal reported, "add to the increasing body of information which supports the wisdom and safety of fluoridation at 1 to 1.2 parts per million in cities in the northern United States, and at 0.7 to 0.8 parts per million in cities in the southern United States where water consumption is greater because of the higher average temperature."

Some opponents say that artificial fluorides cannot be accurately injected into the water system, especially one as large as New York City's is, with its 5,700 miles of pipes. But Armand D'Angelo, New York's Commissioner of Water Supply, Gas and Electricity, says that "fluorides can be injected accurately into the city water system" at the recommended dosage of one part per million, with a 0.1 part margin either way. He also says that the process will be given "a constant check several times a day."

For the case against fluoridation, turn the page

Documenting the case against fluoridation

by John Lear
Science Editor of Saturday Review

Is it unreasonable to plead for caution in the fluoridation of public drinking water until time and research have full opportunity to expose possible undesirable effects of daily doses of fluoride?

Much more documentation in support of such a plea exists in the scientific literature than most readers are aware of. Particularly impressive is a report from Canada.

This report is a review of scientific literature from all over the world. The research papers discussed in it were gathered by the library of the National Research Council of Canada, at Ottawa, at the request of three staff members of the food chemistry section of NRCC's division of applied biology: a laboratory technician, Mr. John Marier; his boss, the food chemistry section chief, Dyson Rose, Ph. D.; and another subordinate of Dr. Rose, Marcel Boulet, Ph. D. The original purpose of these three men's work was to bring together all available knowledge about behavior of calcium phosphate, the principal inorganic ingredient of milk. Since calcium phosphate is also the main inorganic constituent of human bones and teeth, the searchers read many references to reactions between calcium phosphate and fluoride. Among other things, they discovered that fluoride has the ability to prevent calcium phosphate from dissolving, and that this ability is what enables fluoride to affect tooth decay, for the enamel of teeth is a form of calcium phosphate.

Approved by nine specialists

"Accumulation of Skeletal Fluoride and Its Implications" was the title of the paper the three Canadians sent to *Archives of Environmental Health*, which the American Medical Association publishes as the official journal of The American Academy of Occupational Medicine and of the Association of Teachers of Preventive Medicine. Nine different specialists chosen by the editors of *Archives* checked and rechecked the manuscript for a year and a half before finally approving it for publication in May 1963.

The three NRCC scientists took no position on fluoridation of water one way or another. They simply recited from the existing literature on fluoride and then asked questions. The questions, however, were of such a fundamental nature that

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some of the answers will almost certainly be years in the making.

The first fact noted by the Canadians was that the only undeniable and indisputable good that fluoride is known to confer on the human body is conferred in the mouth. Coming into contact with the teeth, it lends to them a tendency toward increased resistance of the tooth enamel to decay. The tendency is not universal, but occurs in something better than half the exposed population in degrees varying with age if exposure takes place up to the age of 16 years. How long the resistance lasts once acquired is a question of sharp dispute. Some say the practical effect of fluoridation—in those persons whose teeth are affected at all—is merely to delay decay by six years. There is some documentation for this view. There is much less evidence to support claims that resistance to decay continues into the fortieth year of life or even longer.

From the mouth the fluoride enters the gut and is either excreted or goes to the bone and soft tissues of the body. Just as too much fluoride in the tooth enamel can malform teeth, so too much fluoride in bones can make a caricature of the human figure. The problem in using fluoridated water, then, is to guarantee protection against excess deposition. The metabolic process involved is not at all understood and in many respects has not even been thoroughly investigated.

It is established that a certain amount of all fluoride ingested—whether in water, food or air—is deposited in the bones of animals, including man. Although the rate of deposition tends to decrease gradually with time, short-term studies of humans show the deposits amount to about half what the body absorbs from the gut. Absorption from the gut may vary from 37 percent to 97 percent of the amount ingested, depending on the nature of the fluoride.

Other chemicals ■ factor

When rats were fed fluoridated water through a stomach tube, to make sure the gut received the measured amount of fluoride, the amount that could be absorbed from the gut was influenced strongly by the presence of other chemicals in the water. When large proportions of calcium, magnesium and aluminum accompanied the fluoride, flu-

Fluoride tends to help tooth enamel resist decay in half of the treated teeth, but how long the resistance lasts once acquired is ■ question of sharp dispute.

oride that went from the gut to the bones dropped by one-third to three-fourths. When phosphate was added to the calcium, a further decrease of one-half occurred.

How fluoride combines

Apparently what happens under these circumstances is that the fluoride is locked up in an insoluble aggregate and excreted in the feces. This appearance seems confirmed by the results of feeding fluoride in bone meal, which contains relatively high proportions of calcium and phosphate. Of the fluoride in the meal, only about a third as much reaches the bones as would reach the bones if sodium fluoride (the form in which fluoride is added to water) were fed. Fluoride in milk likewise is deposited in the bones in smaller proportions than is fluoride in water.

The implications of this line of thought could be significant to the whole structure of reasoning on which artificial fluoridation of public water supplies is built. For proponents of what is euphemistically called "adjustments of the fluoride content of water" base their case on the concept that a fluoride ion is a fluoride ion regardless of where it is found. Therefore, since thousands of people have drunk naturally fluoridated water all their lives with no detectable detrimental effect except for mild mottling of the enamel of teeth when the fluoride content of the water is above a certain known level, it is entirely safe to add fluoride to drinking water up to the minimum amount known to give the mottling effect.

But the Canadians have discovered something that was previously overlooked. Most naturally fluoridated waters in the United States which contain more than half a part of fluoride per million parts of water are hard waters. That is, these waters contain as many as 500 parts of other chemicals to one part of fluoride. The NRCC report observes: "The calcium and magnesium present in this 'hardness' component may provide a protective mechanism, reducing fluoride absorption and its subsequent deposition in bones." Then comes this suggestion for further research:

"A systematic attempt to assess thoroughly the ionic content of various naturally fluoridated waters in relation to skeletal fluoride storage in lifetime residents would reveal the practical significance, if any, of such a phenomenon."

As Colorado Springs goes . . .

The NRCC observations cited above were mentioned briefly in testimony at the marathon hearing preceding the New York City Municipal Council's recent vote for fluoridation of New York's public drinking water. Proponents of fluoridation answered by pointing out that Colorado Springs, one of the most studied towns where the drinking water is naturally fluoridated, has soft water. New York's Mayor Robert Wagner and members of the

The Canadian report says that calcium and magnesium in "hard" fluoridated waters may provide a protective mechanism. New York City's water, however, is soft.

Council accepted this answer as an adequate disposition of the matter.

An item of information not mentioned at the fluoridation hearing appeared in the famous English medical journal, *Lancet*. Death rates for the years 1955-57 in Colorado Springs were compared with death rates for the same years in Utah County, Utah. The water in Colorado Springs has a fluoride content of 2.5 parts per million; the water in Utah County has a fluoride content of 0.5 parts per million. Deaths from cancer of the stomach in Utah County accounted for 2.4 percent of all deaths in the county during the years surveyed; deaths from cancer of the stomach in Colorado Springs accounted for 28.8 percent of all deaths in Colorado Springs during the same years. The *Lancet* item said:

"The precise significance of these figures is uncertain because of the lack of information about a host of modifying factors, such as the age distributions of the two populations." After noting that deaths from stomach cancer in Crowland, Lincolnshire, England, "where the water is naturally fluoridated at 3.5 p.p.m., were more than twice as many over a ten-year period as in Donnington, where the water contains 0.5 p.p.m. of fluoride," the *Lancet* item went on:

"This might be accounted for by chance variations in the two populations, or it might be a 'real' difference, but one not related to the water supply. Such apparently inexplicable local differences have been observed elsewhere, both in this country and in the Netherlands, and could be due to some difference in the organic or trace-element content of the local soils. . . . Too much reliance must not be placed on sets of numerical data alone—assumptions must be tested against a background of sound clinical knowledge and experience."

A fair index?

The pertinence of these facts to the situation in New York City is that New York City's water is soft.

According to the pro-fluoridation argument, Colorado Springs is not a fair index for New York or any other place which "adjusts" the fluoride content of its drinking water upward to one part of fluoride per million parts of water. At that level, it is claimed, the effect against dental decay is achieved without

What is to happen, the Canadian report asks in effect, if water containing fluoride is drunk in amounts tolerable to sturdy folk but intolerable to a faulty metabolism?

danger to anyone. Opponents of fluoridation are challenged to present solid evidence to the contrary.

More than one piece of such evidence has appeared in the foreign literature since publication of the Canadian study in *Archives of Environmental Health* last May. Epidemic skeletal malformations have been reported among peoples drinking water containing as little as eight tenths of a part per million of fluoride in Lebanon on the Persian Gulf, and high percentages of marked mottling of tooth enamel have been registered in Israel where the fluoride content of drinking water is at a comparatively low level.

"It is possible," the Canadians declare, that widespread dietary deficiencies in other lands may contribute to skeletal deposition of fluoride following the drinking of water with a low fluoride content. Contrariwise, "the comparatively high standard of nutrition and general health in the United States and in the British Isles" may explain "the absence of undesirable clinical symptoms" among those who have drunk naturally fluoridated water in those countries all their lives.

But even among the best-fed and most-protected people there are those who, through heredity or other causes, suffer deficiencies of vitamins or blood factors or trace elements of chemicals which must be corrected continually to assure survival.

What, the Canadian report asks in effect, is to happen to these people if the water they drink contains fluoride in amounts tolerable to sturdy folk but intolerable to a faulty metabolism? Fluoride that is not accompanied by other elements that lock it up and hurry it out of the body?

Teeth and bones are not simply fixed fenceposts of the body. They are in a constant state of flux, now giving of their substance to tissues and organs and now taking away. Bones, especially, are storehouses of elements critical to life.

Fluoride is locked into the teeth and bones along with calcium phosphate and magnesium among other things. Is this a healthy prospect?

Magnesium is vital to many life processes, including the stability of the blood.

Calcium is particularly essential to pregnant women, and deprivation of it can damage the foetus.

Since the bones are the emergency storehouse, should any risk be taken

of attaching padlocks to the storehouse doors?

If not, the Canadian report proposed considerable research before any arbitrarily fixed amounts of fluoride are added to water drunk by the sick as well as by the robust.

Aside from research, the Canadians also proposed that it should be possible to put fluoride into milk, where it could bathe the mouth and then, having performed its one useful task in the body, be excreted quickly through combination with the milk's calcium.

In the absence of any uncontested evidence that fluoride aids the human body by preventing dental caries, there would seem to be no logical reason to add fluoride deliberately to the diet.

A permanent medicine?

We take medical remedies only as long as we are sick. When the sickness subsides, we stop the medicine. Why do otherwise with fluoride, which does no demonstrable good outside the mouth and is known to be capable of much harm elsewhere in the body?

Smelling is believing—or is it?

THE luggage looks like leather, and it even smells like leather, but it's really just plastic. Manufacturers who have been able to make many synthetic materials look like the substance they have replaced are now making them smell that way too. Plastic luggage and handbags are being sprayed with chemicals that give them the aroma of leather.

Companies are beginning to realize that odors are important to consumers, and this has opened up a whole new field of olfactory marketing. A New Jersey supermarket sold an extra large amount of frozen berries by filling the store with the fragrance of fresh strawberries. When the odor of oranges was used, orange juice sales doubled.

The Lord & Taylor department store chain uses a different approach. Each week, it spreads a different scent of perfume in the streets in front of its stores to lure customers into its toiletry departments.

Pine scents have been added to plastic laundry bags and plastic clothespins. The rugged odor of tarred hemp is added to ropes and nets made of synthetic fibers to give them that "natural" smell.

Some of this new olfactory engineering is used to overcome offensive odors. Chemists used detergents to eliminate an unpleasant smell in processed seal skins. As an added touch, they created an "exotic perfume" which they believe complements the natural odor of seal skin.

But the chemists still don't have everything their own way. They find it impossible to duplicate some pleasant smells. One of the most pleasant and most elusive is that of fresh baked bread. "There must be a way to match it," says Alfred Neuwald, president of Fragrance Process Co. of New York. "But we haven't been able to find it."

VROOM! out of this world engines

Scientists are working on revolutionary new power plants to put men in space and then keep them going

by Robert M. Loebelson

ONE of the most important challenges American scientists face in space exploration is the evolution of revolutionary new power plants. These engines, now under development, range in size and power from tiny units producing miniscule amounts of power, measurable only by special instrumentation, all the way up to giant rocket engines which will deliver 20 to 30 million pounds of thrust or more.

The basic booster now being evolved for earth takeoff is the F-1, which has a thrust of 1.5 million pounds. Five of these will be clustered to make up the advanced Saturn, which will be used to fire

Reprinted from *Aerospace*.

the Apollo moon vehicle into a lunar orbit. NASA and aerospace industry officials believe the next step in booster thrust will be a rocket producing about 24 million pounds of thrust.

Upper stage thrust

Booster upper stages range from engines with a few thousand pounds of thrust to the 200,000-pound-thrust J-2 scheduled for the advance Saturn. But the M-1, a hydrogen-oxygen engine now being developed, will have a thrust of more than one million pounds. Most upper stage engines now conceived will use hydrogen and oxygen, but researchers concerned with space power systems are seeking propellant combinations which provide higher specific impulses than oxygen and hydrogen and thereby produce more thrust for the same amount of propellant. Among those being considered are hydrogen-fluorine and propellants containing light metals.

Spacecraft engines must contend with a hostile space environment, sometimes riding dormant or coasting for long periods and often confronted with a requirement for variable thrust and multiple starts. These conditions make necessary the development of high-energy propellants which can be stored in the space environment. One of the most promising of the propellants with these requirements is oxygen difluoride-diborane, but fuel specialists know that more answers are needed, especially in the area of shielding propellant tanks against penetration by micrometeroids which might be encountered in space.

And once a vehicle gets into orbit or is fired toward the moon or one of the other planets, smaller space engines are needed to handle attitude control and mid-course maneuvering. Among the problems designers have discovered in trying to develop these smaller space engines is the requirement that the small power plant should preferably use the same propellant as the main engine (to simplify fuel storage), and the difficulties in cooling and getting good performance from smaller engines.

The biggest problem

But the greatest single problem thus far encountered in rocket engine development is something called "combustion oscillation." These oscillations are pressure fluctuations in the combustion chamber of the rocket engine which tend to increase heat transfer and can destroy the combustion chamber if they continue for any length of time. Researchers are attacking this "combustion oscillation" problem on two fronts—by doing basic studies on why these phenomena occur and by developing techniques to control or eliminate the pressure fluctuations.

Space experts know that a vehicle moving in space will be much more efficient if it contains a system to self-generate required power. Among

the space power generation systems now being studied are:

- Solar cells
- Thermionics
- Solar heat engines
- Batteries
- Fuel cells
- Engines using chemical reactants

In addition, researchers are working on thermoelectric systems (in which power is generated by heat), magnetohydrodynamics (in which hot, ionized gas is passed through a magnetic field), solar concentrators and thermal energy storage.

In *solar cells,* the effort is to increase their efficiency over a wide temperature range, improve their resistance to radiation and decrease the cost and weight. One major effort in this area is a solar cell that can be made as a thin film. Large thin film solar cells could be carried in a compact package for unfolding in space or on the moon.

Direct conversion of heat

Thermionic systems convert heat directly into electrical energy and do not have the radiation problems encountered with solar cells. Basic elements of a thermionic power converter are a solar collector, an array of thermionic diodes and associated energy storage and power conditioning equipment. One system now being developed is designed to deliver 135 watts on Mars, weigh only 30 pounds for the collector-conversion unit and be trouble-free for one year.

A multi-kilowatt *solar power system* using turboalternators is also under development. This device involves a solar concentrator, a boiler and heat storage unit, a turbogenerator and associated components, pumps and radiators. With mercury vapor as the working fluid, the present system will deliver three kilowatts of power. But scientists believe this type of system will be usable for 30 or more kilowatts.

Research on batteries

Today's primary method of storing energy for power generation is the *battery.* Current batteries are alkaline electrolyte cells using electrode combinations like nickel-cadmium, silver-cadmium and silver-zinc. Research on advanced systems indicates theoretical energies 25 times as great as nickel-cadmium can be obtained.

Fuel cells, which are compact and have few or no moving parts, have high energy-conversion efficiencies —70 percent or higher. Although the Gemini and Apollo spacecraft will employ fuel cells containing hydrogen and oxygen as the reactants, studies are under way on advanced models. For low temperature fuel cells, liquid or solid membrane electrolyte is considered satisfactory. Molten caustic is being planned for intermediate temperatures and molten salts and solid oxides are considered ideal for high temperatures. Other fuel cell research being conducted involves pulsed operation to reduce the weight of the system and

Besides "conventional" rocket boosters and space power systems, industry and government are deeply involved in efforts to use nuclear power in space

extend its operating life, and studies of biochemical fuel cells which utilize human waste for energy.

Chemical engines can be used to generate space power on missions lasting a few hours or a few days and for intermittent use over longer periods. Several different types, both piston and turbine, are usable. Current studies involve chemical engines which use the same reactants as those employed for propulsion of the spacecraft.

In addition to the "conventional" rocket boosters and space power systems, industry and government are deeply involved in efforts to use nuclear power in the nation's space program. Basically, the goals are to develop: a) nuclear rocket systems and b) nuclear electric power and propulsion systems.

The nuclear rocket will emerge from a development program involving KIWI (ground-based research reactors), NERVA (Nuclear Energy Research Vehicle) and RIFT (Reactor In Flight Test). The reactor technology being obtained from KIWI will be used in the NERVA flight propulsion system and NERVA will be flight tested in the RIFT stage. The RIFT stage will fit the Saturn V launch vehicle.

Nuclear energy for electric power and electric propulsion will be needed in the space program in ranges of hundreds of kilowatts to many megawatts. Among the projects which will require these power levels are orbiting manned space platforms, manned interplanetary spacecraft, communications satellites and unmanned planetary probes. On-board power requirements involve communications, life support systems, data acquisition, and additional power will be needed to propel the spacecraft.

What spacecraft will need

A manned interplanetary spacecraft of the future, however, might weigh more than a million pounds, might require orbital assembly and would need a large electric rocket propulsion system calling for 20 to 30 megawatts of electrical power. Since the usefulness of an electrically propelled spacecraft depends directly on the weight of the nuclear power electrical generation system for the electric rockets, space engine scientists feel they must develop a power generation system of 10 pounds per kilowatt or less, including shielding.

To propel spacecraft electrically, scientists and engineers are studying

three main types of electric rocket engines. The arc jet develops thrust by heating a working fluid (hydrogen, ammonia, etc.) and expanding it through a nozzle. The ion engine involves the use of electrostatic forces and reactions to accelerate a working fluid (cesium, mercury, etc.) to develop thrust. The plasma engine uses electromagnetic forces to accelerate plasmas to develop thrust. Although the arc jet is the electric engine considered closest to attainment, all three types require extensive development and testing before they will be ready for use in space. A test program is already planned by NASA and AEC as Project SERT (Space Electric Rocket Test).

Step-by-step advancement

Right now the problem areas are so varied that the advancement will come only after a step-by-step learning process covering all types of engines usable in space.

Like mother, like child, or vice versa?

Is a child irritable because he happens to have an irritable mother? In recent years, psychologists and psychiatrists have implied to parents that their child's behavior depends strictly on what the parent does. Now the trend seems to be going the other way. A child at birth has certain innate personality characteristics, molded to some extent by what the parent does, but not strictly dependent on it.

At Albert Einstein College of Medicine, New York City, a psychiatrist and a psychologist are doing some new research into the age-old question of how much is accounted for by heredity, and how much by environment. They tickle, whistle at, and otherwise stimulate newborn babies to find out if there is an inborn pattern of behavior. More than 300 newborns have been tested in the last six years, and so far the experiments show that every newborn seems to have a behavioral and body-response pattern all his own.

In the Einstein studies, Dr. Wagner Bridger, psychiatrist, and Dr. Beverly Birns, psychologist, have found at least three different types of babies (although there may be more) that they labeled unresponsive, moderately responsive and extremely responsive. To find them, the researchers used various stimuli-irritants: a low tone, a loud tone, a cold disk, a blast of cool air and a pacifier. They used a polygraph (lie detector) to clock the infant's heart rate, breathing rate and other physiological reactions. The pacifier was electronically connected to measure the baby's sucking power.

Dr. Bridger concludes that probably no one way of bringing up a baby can be right for all babies. He adds: "It seems likely that the so-called basic temperamental differences may be important in the ultimate results of various child-rearing practices."

Guilt is good for you

CAN science help in man's quest for moral values?

Yes, says a Louisville psychiatrist. Science can help if it attacks some of the bases for misunderstanding—the causes of such things as hatred and pride and selfishness.

Dr. Robert J. Lehman, who teaches at the University of Louisville Medical School, recently contrasted personal wishes, which originate within ourselves, and duties, which are taught to the individual by forces outside him.

"As one matures, the sharp contrast between wishes and duties tends to become obliterated," the psychiatrist explained. "Duties become so automatically accepted that they are almost a part of the self.

"Emotional maturity enables us to minimize personal needs and allows a greater flexibility in our behavior."

He emphasized that human integrity—defined as a wholeness of personality—involves a duty content greater than wish content. "For the mature person, integrity is part of action," Dr. Lehman said. "Moral action is a result of such integrity."

While a child should not be subjected to continuous parental hostility or treated unfairly as he gropes toward self-acceptance, it is also unfair to place too few restrictions on the child, the psychiatrist emphasized.

Sensible restrictions and commands give the child a source of identification with the adult world, he explained. Linked to the sense of restraint is the sense of guilt. "Guilt is good," Dr. Lehman declared. "We have to have a sense of guilt to function as human beings."

He concluded by defining seven requirements in man's search for integrity:

1. The ability to function realistically.
2. The ability to maintain a capacity for change.
3. The ability to control anxiety.
4. The capacity to give more than receive.

5. The ability to maintain good relationships with others.

6. Maintaining adequate outlets for aggression and guilt feelings.

7. A capacity for love.

How much pain can you stand?

Reaction to pain not only differs with each individual, but often differs from time to time within the same individual.

A person's capacity to bear pain is mainly a matter of temperament, say researchers. One study, for example, indicates that a person's reaction to pain may often depend on how he saw his parents behave under similar circumstances when he was a child. If the parents reacted impassively and controlled their emotions, the chances are the person will too. If the parents were highly emotional, moaning, grimacing and clenching their hands dramatically, then he may react in a similar fashion.

Another study, this one by British scientists, shows that merely expecting pain is enough to make pain felt more intensely. In one experiment, when the word "pain" was included in instructions to test subjects, they sensed electric shock more acutely than other subjects whose instructions did not contain the word.

That expecting pain can actually make a person more sensitive to pain is common knowledge to anyone who has ever been extremely worried that a scheduled visit to the dentist would be painful. Once at the dentist, the session invariably has proved to be far more painful than it should have been.

It all has to do with a person's "pain threshold." This is the built-in ceiling, the intensity level below which pain is tolerated and beyond which pain becomes unbearable. Anxiety over expected pain is not alone in lowering the "pain threshold," Drs. W. P. Chapman and C. M. Jones of Massachusetts General Hospital have found that lack of sleep will do it too. Their studies have shown that a person who has been deprived of sleep to the point of extreme fatigue, will be more sensitive to pain than normally.

At New York Hospital, some years ago, Dr. James D. Hardy and a team of researchers pioneered with an instrument called a "dolorimeter," with which they were able to produce and measure pain. The instrument used a lens that focused the heat from an electric bulb on a blackened area of the skin.

Dr. Hardy found that pain reached its excruciating maximum when the skin temperature reached 152°, or about the intensity of a grease burn. After that, the pain remained constant, no matter how much heat was turned on.

However, Dr. Hardy in his studies

could not answer the question of how much pain a person could possibly stand. His instrument could not measure the limits of human endurance to pain. The reason is that sudden pain, even of less intensity than a grease burn, if it lasts long enough, can overwhelm the higher nerve centers so much that a person may fall into a faint.

The trouble with sex education

We have to change our present methods of teaching about sex as though we were "teaching about disease." So says Dr. Lester A. Kirkendall, professor of family life at Oregon State University.

"We are preoccupied with the dangers of both," according to Dr. Kirkendall, "with ways of immunizing against them and with other avoidance techniques, and with detailed discussions of the threats they pose."

Dr. Kirkendall stated his views at a symposium on "The Family's Search for Survival," at the University of California Medical Center.

He recommended that sex be dealt with in context, not as a casual, isolated sensory outlet. He pointed out that highly mature people enjoy sex "so much more intensely than the average person, yet at the same time considering it so much less important in the total frame of reference."

He urged that sex education should be part of human relations education and should continue throughout life.

That happy native nonsense

The popular belief that the "happy" native lives a life of uncomplicated bliss in his primitive environment is romantic nonsense.

"Primitive societies do not naturally enjoy a healthier mental outlook than industrialized communities," says Dr. Charles C. Hughes, associate professor of sociology and anthropology at Michigan State University. Dr. Hughes is coauthor of a recently published study, *Psychiatric Disorder Among the Yoruba*. The Yoruba are one of the major tribes of West Africa.

"I am more impressed," Dr. Hughes states, "by the similarities than the differences of mental disorders among the Yoruba and the literate, Western social group in Nova Scotia, studied earlier, on which our Yoruba research was based."

While the incidence of mental illness is somewhat less marked among the Yoruba, he says the types of disorders are much the same as those prevalent in the West, mainly psychoneurotic, not psychotic. They suffer from anxiety over social status, economic problems and personal relations just as do Americans."

Meet the ghost kangaroo

Three Lions photos

IN A secluded, 37-acre private park called Mona Vale, in Australia, an animal-loving millionaire is developing a new type of animal, the albino or ghost kangaroo.

Albinos occur occasionally among all animals, but unless carefully nurtured, they remain a rarity. Philanthropist Sir Edward Hallstrom began breeding ghost kangaroos about 12 years ago. He paired a wild, 18-month-old albino wallaroo (large mountain kangaroo) with five mates, all normally colored, as were their subsequent daughters.

The albino was then bred with his daughters and his grand-daughters—and three years ago, the first two tame albinos were born.

By continual in-breeding and cross-breeding, plus a special diet, Sir Edward hopes to increase the number and strength of his herd. He now has over 40.

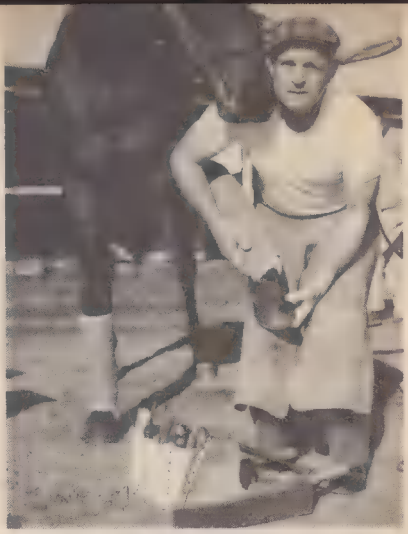
Millionaire Sir Edward Hallstrom holds one of his creations. To Sir Edward, the white kangaroos are "fantastically beautiful."

Using his tail as a balancer, a ghost kangaroo (above) leaps through the underbrush. Sir Edward says, "Sometimes I really do get the impression I'm seeing ghosts."

Chow line at Mona Vale (right). Ghost kangaroos line up for lunch of alfalfa meal seasoned with oats, vitamins and minerals. For breakfast they get fresh alfalfa. During the rest of the day they nibble grass.

Inventor of the month

How to keep racehorses in the running



Bill Bane holds the hoof of Olympiad King. He used the patented "Bane Patch" to help heal the horse's cracked hoof.

BILL BANE'S "mystery patch" has become famous around the race tracks. Applied to a hoof afflicted with a quarter-crack, it has kept many a horse in important races that the owner did not want to miss.

Bill kept the process secret until the recent issuance of his patent (No. 3,118,449). Now that he has protection for 17 years, he intends to instruct assistants in applying the patch. The demand for his own services has kept him flying from his home in La Cañada, Calif., to stables in the East and South.

On the day before his patent was issued, he was doing a repatching job on Su Mac Lad for Stanley Dancer, a leading trotting horse driver, at New Egypt, N.J. When he got home he was called to Louisiana to see what he could do for Hurry To Market, threatened with withdrawal from the Kentucky Derby because of a leg injury, and to patch up Piper's Son for a New Orleans handicap.

The Inventor of the Month (full name William R. Bane) drew on his 30 years' experience as a horseshoer in devising his patching process. He is credited with enabling Su Mac Lad, owned by Irving W. Berkemeyer, to become the greatest money-winning trotter in track history. After treatment in 1962, the 8-year-old gelding won enough races to be acclaimed harness-racing older horse of the year.

The system has been effective, the inventor says, with thoroughbred harness and quarter horses. The handicap horses he has treated include Prove It and Pixie Erin.

The chief patching material, about which trainers had been curious, was disclosed in the patent to be strips of synthetic rubber such as that made under the trademark Neolite. The exact treatment is varied according to the nature of the crack, and steps are taken to protect the horse from infection.

A quarter-crack usually starts at the hair-line and runs down the hoof, exposing a raw area. The injury results from pounding on the track. Conventional treatment has been to medicate the infection, remove a section of the hoof, and let the horse grow a new hoof. The rest and retraining might keep him out of com-

petition for seven months or more.

The 1962 patching of Su Mac Lad took about eight hours, and the horse was able to work out the next day and resume racing in less than a week. Most of the hoof behind the crack was removed, and a shortened shoe was attached ahead of the crack. Over the rubber patch, a plastic cement and adhesive tape were applied. The patch was cured by heat from an infrared lamp, the tape was removed, and the patch surface was finished to conform to the shape of the horse's hoof.

After three months, the hoof grows down sufficiently so that the average thoroughbred or standardbred can race without a patch.

—Stacy V. Jones

INVENTIONS
PATENTS
PROCESSES

You can say it under water

A demonstration of the "Watercom," the new underwater communications system.

An underwater communication system that does away with the need for special receiving equipment has been introduced by the Bendix Corp.

The device, known as "Watercom," will enable a diver to talk to all others beneath the surface of the water within a range of 100 yards. The sound of his voice is amplified right through water.

The system includes an electronic transmitter which attaches to the diver's air tank, a special mouth mask that allows the diver to move his lips freely and enunciate his words, and a throat microphone. According to the manufacturers, any standard breathing apparatus can be attached to the mouth mask, and it can be used with any standard face plate. The diver's breathing regulator connects to the mouth mask, replacing the mouth bit which the diver clenches in his teeth.

The transmitter is housed in a cylinder approximately 14 inches long which fastens to the diver's

air tank by means of a metal strap. At one end of the cylinder is a transducer which transmits through the water. "Watercom" is battery powered and can be operated at any depth.

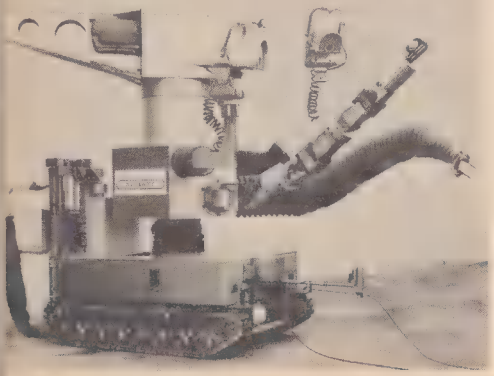
A boat-based version of "Watercom" is also available. It includes a transducer and hydrophone which are hung over the side of the boat into the water, and a person using an ordinary microphone will be able to talk to all other divers within 150 yards of the transducer.

The hydrophone enables the unit to pick up the sounds from below the surface. Thus, a diver using "Watercom" can conduct a two-way conversation with the operator of the boat unit.

The robot named Mobot

Mobot, a remotely controlled robot, is going to work in places where even angels may fear to tread. The Hughes Aircraft robot system has been delivered to the National Reactor Testing Station, Idaho Falls, Idaho.

Looking like a creature out of science fiction, Mobot is readied for "hot" work.



The uniquely equipped, 8½-foot high, 7,000-pound roving manipulator is designed to perform tasks in environments which are too "hot" for man.

Dominating the appearance of this Mobot is an overhead jib crane which can pick up a half ton and is mounted on a turret which can be swiveled 450 degrees in either direction. A forklift assembly on the front of the vehicle is also capable of lifting a half ton.

Mobot is equipped with two six-foot arms encased in rubberized boots. Each arm has a "shoulder," "elbow" and "wrist." Changeable "hands" of different sizes and shapes are available for a variety of tasks. Each arm is capable of lifting and carrying 100 pounds when fully extended.

All of the motions of Mobot are controlled from an operating console equipped with "wobble-stick" switches mounted on a panel directly in front of the vehicle's human operator.

Mobot's "eyes" are two closed-circuit television cameras mounted on flexible booms just above the arms. The cameras can be moved in all directions. Because Mobot may be required to travel over rough terrain, it is equipped with continuous tracks similar to those found on tanks.

A line of underwater Mobots is now being designed to assist in deep sea petroleum drilling.

But can it wag its tail?

Engineers at Honeywell have developed an "electronic bloodhound" which they say has many of the attributes of the hairy kind. It's sensitive, trustworthy, loyal, hard-working and barks an alarm when anything goes wrong.

The Honeywell hound is designed to detect scents that may be dangerous in a cleaning establishment, a hospital, laboratory or factory. It works on the principle that some gases absorb more ultraviolet radiation than others. The device has a special ultraviolet lamp focused on a sensitive detector tube. When the gas comes between the lamp and tube, part of the ultraviolet radiation is absorbed by it, cutting down the amount received by the tube and triggering a mechanism which can either turn on ventilating fans or sound an alarm or both.

The sensitive electronic unit detects odors as slight as one part in one million parts of air. First application will be in coin-operated dry-cleaning plants. Here the unit will detect perchlorethylene, a toxic gas used in the cleaning process.

To make sure its "nose" is always up to sniff, the unit has a clever self-checking system. Once a day, a slender test tube filled with a sample of the gas automatically rotates down between the ultraviolet lamp and the sensing tube. The unit resets itself, moves the test tube up out of the way and goes back to work. If it cannot reset itself, it turns on an alarm.

A pair of bloodhounds—the hairy kind and the electronic kind. The electronic one has a "nose" so sensitive that it can detect one part per million of a gas. It can then sound an alarm or turn on a fan.

for the home

Top-opening paper matchbook

After nearly 65 years, one of the most widely read phrases in the English language—"Close Cover Before Striking"—may begin to disappear from the American scene.

Top-opening paper book matches are now being produced by Click Bookmatch, Inc. of Owings Mills, Md. The same company is already distributing costlier wooden matches imported from Italy, with the same

You don't have to close this cover before striking. It snaps closed itself.

top-opening feature, but the new matches are the first ever produced in paper.

According to the company, the new book will practically snap shut automatically before a match can be struck. Users will no longer consciously have to close the cover. The cover uses one piece of cardboard which curves at each end and overlaps to form an opening at the rounded top of the book.

In addition, the new cover has 25 percent more visible space for advertising on the inside. So what? Well, book match advertising is a $30 million business.

Flexible magnets

Most people think magnets must be rigid, metal, and shaped like a horse shoe. Not any more.

Retail stores all over the country now have a new type of magnet in the form of 18-inch lengths of flexible ribbon. It can be cut into pieces of any size with a knife or scissors —and every piece, no matter how small, continues to be a complete magnet.

The product, called Koroseal flexible magnetic strip, is made of a thermoplastic containing magnetized particles of barium ferrite, by a division of the B. F. Goodrich Co. Magnet Sales Co., Los Angeles, is now packaging and selling the flexible magnet.

Some of the uses for the plastic magnet strip are: mounting on the front of vacuum cleaners for picking up needles and other metal objects; silent door catch on cupboard or cabinet doors; holding a thermometer on the inside wall of your refrigerator; holding road maps on the car dash panel for easy reference.

Kill that butt

The Surgeon General's report got people thinking not only about cancer but about other cigarette hazards as well. The New York City Council got so worried about the fire hazards of smoking that it passed a law forbidding smoking on hotel, motel or other public beds.

Meanwhile, a West Coast company has issued a whole line of cigarette snuffers designed, not to stop you smoking, but to stop your cigarettes once they have been smoked. There are snuffers that hang on keychains, magnetic snuffers for your car, porcelain snuffers for your home, etc. The prices vary. They can be obtained from Stover Co., Dept. S.J., 2831 Castle Drive, San Jose, Calif. 95125.

Dr. Cornelia B. Wilbur, Psychiatrist and Psychoanalyst; Diplomate of the American Board of Psychiatry and Neurology; Associate in Psychiatry, College of Physicians and Surgeons, Columbia University; President Elect, National Association of Private Psychiatric Hospitals.

Homosexual men and women

How they get that way and how they can be treated. A revealing interview with Dr. Cornelia B. Wilbur on the latest psychiatric findings.

Interview conducted by Flora Rheta Schreiber

POSSIBLY the most misunderstood phenomenon in the psychological experience of our time is homosexuality. Socially and sometimes politically, homosexuals have been objects of misunderstanding and even outright abuse.

Dr. Wilbur, an eminent New York psychoanalyst who has treated homosexuals, was one of a team of psychoanalysts who carried out a ten-year study of male homosexuality and is currently carrying on a study of the female aspect of this deviancy. In an interview for *Science Digest* (see next page), she helps clarify the changing concept of the origins, development and potential reversal of homosexuality.

Homosexuals are made, not born. Underlying their deviancy is the fear of normal male-female sexuality engendered in childhood.

Can you tell us what the point of view is with regard to the origins of homosexuality?

"Homosexuality: A Psychoanalytic Study of Male Homosexuals," of which I am one of the authors, supports the thesis that fear of heterosexuality (normal male-female sexual activity) underlies homosexuality. This fear is engendered in childhood. It is the result of an interplay of powerful psychological forces within the family.

Are you saying that homosexuals are made, not born? Are you saying that it is their early environment that predisposes them to this way of life?

That is what I am saying. Our study helped to define and extend concepts of the relative roles parents play in the development of homosexuality.

It is the immediate environment of the developmental years that makes a homosexual. The actual expression of homosexuality—the "acting-out" as we call it—may be restrained or repressed for many years. But the sexual interest, though not necessarily the overt action, of the homosexual during these years is toward a person of the same sex.

What is the commonest family interaction in the making of a homosexual?

Each parent has a specific relationship with the homosexual son that seldom occurs with other children in the family. Most often the father is detached and hostile. He may be either. In all instances the father contributes to the son's homosexuality through hostility, indifference or default.

The mothers of homosexual sons are most frequently close-binding and over intimate. The homosexual son is often the favorite of the mother. Some of these mothers are openly seductive. Even those who do not actually play the seductress are sexually provocative in their over-closeness.

Since it takes two parents to create a homosexual, we can then assume, can we not, that either parent, by playing a

truly constructive role, can prevent the possibility of homosexuality irrespective of the other parent's behavior?

Our study suggests that this is so. When we compared the parents of homosexuals with parents of other male patients undergoing psychoanalytic treatment, it became clear that a mother can be close-binding, even seductive and if the father is not detached, aloof, or hostile but rather relates to the son with some warmth and masculine encouragement the son will not become a homosexual. As long as the father takes a masculine role and encourages the son to identify with a masculine image, the son does not become homosexual. Even when the father does not provide this model, but the mother's brother or some other adult male family member does, homosexuality may be averted. A mother, even though she is close-binding and sexually provocative, can herself forestall homosexuality when she shows that she is pleased with her son's masculinity and is comfortably related to his sexual curiosity and heterosexual responsiveness to her and other females. In doing these things she encourages and reinforces a masculine identification.

Is there, then, an ideal paternal relationship that not only averts homosexuality in the children but sets the stage for healthy sexuality?

Parents who enjoy a love relationship with each other and provide a stable and affectionate atmosphere in the home, foster healthy sexual adjustments in their children. Where such a relationship exists there is scarcely any likelihood of the mother's seeking exclusive possession of one of her children. Homes in which the husband-wife relationship is faulty and parents use the child as the means of fulfilling their own ungratified longings become the breeding ground for faulty sexual adjustment, including homosexuality. A woman who is unhappy in her marriage may single out a son as a husband-substitute. The mother thus encourages and thwarts the unconscious sexual feelings of her son for her, intensifies his rivalry with and fear of his father, and alienates him from his father. The father becomes hostile to both wife and son. This is one outcome we saw among the homosexuals studied.

You say that, by selecting a son as husband-substitute, the mother may elect the boy for a later homosexual role. Is just one child in the family singled out for this role?

Our evidence points in this direction.

In a typical family where a girl child is destined to become a homosexual, the mother is domineering and excessively controlling.

Do you rule out the possibility of homosexuality through heredity?

Yes. There is no evidence of anything abnormal about the male chromosomes in the homosexuals who have been studied for chromosomal defects. If heredity played a part, we would expect to find significantly more homosexual siblings in our homosexual group than among the comparison group studied. Such was not the case. The majority of homosexuals studied did not have homosexual siblings.

Let's talk about the female homosexual. I understand that you are currently engaged in an ongoing study of female homosexuality. Are the points you have already made applicable to women?

The general hypothesis of the study on female homosexuality is that some of the same concepts do obtain. Female homosexuality is also rooted in incapacitating fears of the opposite sex.

What are the parents of the female homosexual like? What is the typical family situation?

There is some agreement on the part of the members of the committee studying female homosexuality, on which I am serving, as to the "typical" mother and the "typical" father. The mother is domineering in the family and excessively controlling in relationship to the girl child who is destined to become a homosexual. The relationship between the mother and the female homosexual, moreover, is usually a very active one in which there is a "chronic struggle" in which the child is invariably the loser. The commonest techniques the mother employs are rejection, or threats of rejection, derogation and the inducing of guilt feelings in the girl. The girl in turn regards her mother with hostility and rebels against her. At the same time, this girl is caught in a terrible conflict because, even while she rebels against her mother, she has great longing for her affection and approval.

Many female homosexuals state that with the onset of

puberty and dating they are cautioned, warned and even threatened, by their mothers and sometimes by other adult females in the family about the sexual dangers implicit in the boy-girl relationship. Conversely, never a word is spoken about any sexual dangers implicit in a girl-girl relationship.

What role does the father play? It cannot be the mother alone who makes a homosexual.

The father tends to be passive, detached, ineffective. The homosexual daughter considers him weak. Frequently he is over-anxious where his daughter is concerned. Occasionally he may be "maternal" rather than paternal. Always this daughter is unable to make identification with the mother to whom she is hostile and at the same time cannot build a relationship with the father who fails to present a strong, masculine ideal.

Family dynamics are crucial then in the making of both the male and female homosexual. Do changes in the balance of relationship alter the probability of reversal to heterosexuality with treatment?

Yes. We might go so far as to say that even some improvement in the family relationship, if it occurs early enough in the child's life can lead to heterosexuality. For example, if a father is not detached from his son, despite a range of undesirable paternal attitudes, he will nonetheless tend to introduce an element into their relationship which, among homosexuals, favors recovery and, among heterosexuals, militates against homosexual problems.

How do brothers and sisters function in the family setting? Can they play a part in preventing homosexual development?

In the case of the homosexual, siblings may "tip the scales" one way or another. A good sibling relationship may to some extent at least compensate for a poor one with the parents. It may even reinforce a heterosexual adaptation in a child who might otherwise have become homosexual. At the same time, a rivalrous, disturbing sibling relationship, or sibling behavior outside the family which is traumatic to the child even when not directed at him, may be the "final straw" to precipitate homosexuality. But we must remember that sibling relationships, important though they are, are secondary and not primary in creating a homosexual.

To prevent homosexuality, parents must do something about their own emotional health and the emotional climate in the home.

Do male homosexuals prefer men to women socially as well as sexually?

Male homosexuals, with few exceptions, report that they prefer men to women not only sexually, but socially. Their preference, however, is not reflected in their relationships with male siblings. Actually the opposite is true. The male homosexuals in our study hated their brothers much more frequently than they did their sisters, and they hated their brothers more frequently than did the male patients in the comparison group. A reverse pattern prevails for positive attitudes. Usually a male child tends to admire male siblings in preference to female siblings. The homosexuals studied preferred female siblings to male siblings.

Could an alert parent discern telltale signs of homosexuality in a young child?

The boy who develops into the homosexual male often is excessively fearful of physical injury in childhood and avoids fights engaged in by most boys. Nor does he participate in competitive games and sports. He also tends to remove himself from boys of his own age and often plays predominantly with girls or by himself.

Do these children show any special identifying physical characteristics such as clumsiness?

No. Anxiety, however, may give them a sense of clumsiness and lead to poor motor coordination. Feelings of being fragile imbued by anxious parents may lead to avoidance of play and of consequent mastery of games.

In the male, are there signs of what is popularly called effeminacy?

Most of the homosexuals studied were men without effeminacy. Where effeminacy occurred or had occurred, we could not establish a relationship with any other factor studied. We did not find any association between effeminacy and a desire to be a woman. The absence of an association between effemi-

nacy and a desire to be a woman supports our assumption that effeminacy is an unconscious masking of masculinity rather than an emulation of feminity.

Is it possible to classify some children as "prehomosexual"?

Yes. Predictions, however, are not infallible. In our study, we found nine exceptional cases among men who revealed these tendencies, yet did not become homosexual.

What made the difference in these cases, or, in other words, what prevented homosexual development?

Usually the saving dynamic is a male who is a masculine ideal or a mother who responds positively to the boy's heterosexual strivings.

What can parents do to prevent homosexuality?

They should avoid a bad marriage and the sort of family behavior such a marriage engenders. Or they must do something about their own emotional health and the emotional climate in the home before they can hope to do anything about their children.

How does the homosexual problem affect non-homosexuals?

It increases the scarcity of eligible males and females. It leads to some highly abnormal marriages.

Are there ways of sublimating homosexuality without achieving heterosexuality?

No. There is no specific sublimation of homosexuality. There can be repression of sexuality. Such persons do not become homosexuals but asexual or frigid.

In adolescence, is homosexuality ever normal?

Girls go through the crush stage. Boys may indulge in hero worship. These are normal stages of development and do not indicate homosexual tendencies. At the same time, Kinsey has reported that actual homosexual experience is very widespread. The non-homosexual male or female, however, has few such experiences and stops such activity. The male, experiencing the kind of family relationships already described for the homosexual, does not stop.

Do adult homosexuals show signs of heterosexuality?

Homosexual behavior has been reversed by psychoanalysis in a sizable number of cases studied, but lengthy treatment is crucial.

Yes. Certainly this is true in an overt way of bisexuals. But it is also true in covert ways of other homosexuals who show heterosexuality in their day dreams, in their fantasies and in their accidental associations.

What kind of partner does the homosexual seek? I am thinking in terms of matching and opposing characteristics.

Most male homosexuals in our study were attracted to "masculine" qualities in another male, although a substantial minority showed a preference for "feminine" qualities. Concepts of "masculinity" and "feminity" generally conform to cultural stereotypes. The partner in nearly two thirds of the cases in the study was identified, consciously or unconsciously, with some member of the man's childhood family. When the homosexual identified his partner with the father or brother, masculine characteristics were usually sought. Conversely, when the identification was with the mother or sister, he usually sought feminine traits in the partner.

Also sought in the partner are warmth, friendliness, permissiveness and physical contact. The last mentioned can be any type of physical closeness, not necessarily outright sexual relationship.

What is meant by "latent" homosexuality?

The latent homosexual may have a severe homosexual problem that he does not act out and which therefore is not overt. He may marry and homosexuality remains a hidden obstacle to successful relationships with his wife, both sexually and in other areas. Many experts have questioned the concept of "latent" homosexuality on theoretical and clinical grounds. It is all too easy to use the term "latent" homosexuality as a catchall for all difficulties in relating to the opposite sex. Superficial resemblance to commonly accepted characteristics of the opposite sex are therefore viewed as insufficient evidence to establish the presence of a fully developed and mature dormant process (homosexuality), ready to emerge to a manifest state.

Do all persons have some homosexual tendencies even though these tendencies are admittedly suspect and vague?

We do not believe so!

You and other psychoanalysts have treated homosexuals. I know that we cannot speak of curing a homosexual, but I do know that psychiatrists have effected astonishingly successful reversals of homosexual behavior. How treatable are homosexuals? What are the prerequisites for a successful "reversal"?

Of 72 patients who began treatment as exclusive homosexuals, 14 (19 percent) became exclusively heterosexual. Of 30 who were bisexual at the beginning of treatment, 15 (50 percent) became exclusively heterosexual.

Is the length of treatment important to its ultimate success?

Duration is crucial. Again the facts speak for themselves. Only two of 28 patients (7 percent) who had fewer than 150 hours became heterosexual. Nine out of 40 (23 percent) of the patients who had 150-349 hours of psychoanalysis became heterosexual. Eighteen of 38 (47 percent) of the patients who underwent 350 or more hours of psychoanalysis became heterosexual.

You speak of treatment in terms of 350 hours of analysis or so. Does this mean that treatment is expensive?

First you have to consider that 350 hours of treatment is spaced over a 3½ year period. This is time-consuming. Yet, considering it in terms of a total life adjustment, 3½ years is a very brief time. The cost of psychoanalysis during this period would be in the neighborhood of seven to eight thousand dollars. This does not mean, however, that persons who need but cannot afford such treatment are necessarily excluded from it. Their hope lies in clinics where they can secure treatment. Happily, the number of these clinics is expanding under the President's Program for Community Mental Health. Though there are not yet enough of these facilities, they are growing steadily. The problem is not one of financing, but of staffing with adequately trained psychiatrists and psychoanalysts. The educating of enough doctors equipped to handle homosexual problems and fill the need of the new clinics is the core of the problem.

Do drugs and tranquilizers have any effect?

In individual cases, female homosexuals are being treated successfully, but analysts say it's difficult to keep them in treatment.

The present view is that they do not.

Are there special factors that increase the probability that the homosexual will see his phychoanalysis through to a successful conclusion?

Yes. The chances of stick-to-itiveness are greatly enhanced when (a) the patient thought of his mother as an admirable person and one who was considerate of his needs; (b) the patient was not an only child; (c) the patient acknowledged a sense of rivalry or competition with his brothers; (d) the patient had established his first heterosexual contact by the time he was sixteen; (e) the patient wanted to conceal his homosexuality.

Conversely, what are the factors that lead the patient to discontinue psychoanalysis at an early date?

He will have difficulty when (a) he had parents who spent very little time together; (b) he was an only child; (c) he had homosexual physical contact but not heterosexual experience before the age of sixteen; (d) he had never attempted heterosexual genital contact; (e) he did not care to conceal his homosexuality.

What indications, then, favor a successful reversal of homosexuality and an exclusive heterosexual adaptation?

We are most hopeful when (a) the patient was bisexual at the beginning of analysis; (b) he began the analysis before the age of thirty-five; and (c) he continued in analysis for at least 150 hours, preferably 350 hours or more.

An interesting finding is that certain factors such as the complicating presence of a diagnosis of schizophrenia in the homosexual patient, previously regarded as influential in affecting the treatment, just did not prove to be so. Nor did the theoretical orientation of the analyst have anything to do with the outcome. "Freudian" and "Culturalist" psychoanalysts were equally successful in effecting change in sexual behavior. Moreover, the sex of the analysts did not affect the outcome.

Of what does the treatment consist?

Depth psychoanalysis is essential. Through this process personality distortions are revealed and the childhood re-evaluated.

How does the treatment of female homosexuals compare with that of males?

We do not have enough evidence to say. Psychoanalysts report that it is difficult to keep women homosexuals in treatment. There are today among our cooperating psychoanalysts' patients less than one half as many female homosexuals in treatment as males.

How do you explain the difference?

The reasons for this can only be speculative. The female homosexual is not in as difficult a situation socially as the male homosexual. Our society does not point a finger at her as readily as it does at the male. To think that the woman homosexual is "better adjusted" than the man and therefore does not seek or require treatment is a snare and a delusion. Experience with every case of female homosexuality demonstrates that there is a great deal of psychopathology and much associated symptomatic distress.

Is treatment for female homosexuals successful?

In individual instances, yes.

What are the implications of your study for prognosis in effecting the reversal from homosexuality to heterosexuality?

We assume that heterosexuality is the biologic norm and that unless interferred with, all individuals are heterosexual. Homosexuals do not by-pass the heterosexual developmental phases and all remain potentially heterosexual.

We are firmly convinced that psychoanalysts can set a heterosexual objective in treating homosexual patients rather than "adjust" even the more difficult patient to a homosexual destiny. A conviction based on scientific fact that a heterosexual goal is achievable helps both patient and psychoanalyst to take in stride the inevitable setbacks during psychoanalysis.

EDITOR'S NOTE: The book *Homosexuality: A Psychoanalytic Study of Male Homosexuals,* of which Dr. Wilbur is coauthor, is published by Basic Books, Inc., New York ($8.50). A similar report on female homosexuals will follow.

Way out quiz

The National Aeronautics and Space Administration's budget for the space program in 1965 is $5,350,000,000. That's a lot of money, but there's a lot of space to explore. What do you know about the space nearby?

by John and Molly Daugherty

1. On which of these planets would you have no birthday anniversaries to celebrate?
   a. Mars
   b. Pluto
   c. Jupiter

2. Which planet was the first to be discovered by calculating where it was and then looking for it?
   a. Neptune
   b. Uranus
   c. Pluto

3. On which planet would you have the shortest workday?
   a. Mars
   b. Neptune
   c. Jupiter

4. Which of these planets is the densest (*i.e.*, has the greatest mass per unit volume)?
   a. Neptune
   b. Jupiter
   c. Earth

5. Of these planets, which one has man actually never seen?
   a. Venus
   b. Mars
   c. Mercury

6. The sun is most like:
   a. An A-bomb
   b. A hydrogen bomb
   c. A giant pile of ordinary fuel

7. On which of these planets would you face the greatest atmospheric pressure?
   a. Saturn
   b. Mars
   c. Mercury

8. Which planet has almost continuous day at one pole and night at the other?
   a. Saturn
   b. Uranus
   c. Neptune

9. Which planet changes its speed more than 40,000 miles an hour as it goes around the sun?
   a. Earth
   b. Venus
   c. Mercury

10. If you ate three meals a day on the moon, about how long would it be from lunch till dinner?
   a. Six hours
   b. One week
   c. One month

Answers:

1 - b Pluto A year is the time it takes the Earth to go around the sun. If you accept this definition of a year, your birthday wouldn't come up for 248 years on Pluto. Pluto takes so long because it is so far from the sun, its orbit is so great and its orbital speed so slow compared with those of the other planets.

2 - a Neptune The planet Uranus varied a little from its predicted orbit, so the assumption was made that another planet beyond it was the cause. The really scientific detective work involved the precise calculation of the position of the unknown planet at a given time. John Couch Adams in England and Urbain Leverrier in France both calculated the position in the 1840's. In 1846, Johann Galle, a German astronomer, made the discovery using the data Leverrier sent him. Within half an hour, Galle found the planet in the position predicted.

3 - c Jupiter It rotates on its axis in about 10 hours. Day and night are each 5 hours long. No other planet rotates so fast, although Saturn takes only a half-hour longer.

4 - c Earth In fact, the Earth is the densest of the first eight planets. The density of Pluto, the ninth planet, is unknown. The Earth is 5.5 times as dense as water. Venus is next in density with 5.1. The outer planets Jupiter, Saturn, Neptune and Uranus have densities less than 2. Saturn has a density so small that it is less dense than water—about .7 as dense.

5 - a Venus Venus has so uniform and opaque a cloud cover that man has never viewed its surface. Data obtained by the Mariner II rocket probe indicates a surface temperature of 800°F., yet the outer atmosphere is quite cool—30°F. generally. There is little difference in temperature on the dark side of Venus, which may mean that terrific winds at the surface carry heat around Venus. The cloud cover is so dense that the surface of Venus may be quite dark.

6 - b Hydrogen bomb The sun is like a hydrogen bomb—but under control. The radiation from the sun comes from nuclear energy. The sun is 70 percent hydrogen. Every sec-

ond about 800,000,000 tons of hydrogen are being converted to helium in a fusion process. Roughly 4,000,000 tons of the sun's mass are radiated as energy. In the fusion process, a small mass is converted into a vast amount of energy compared with ordinary burning. The mass of the sun is so great that the process will probably continue for billions of years.

7 - a Saturn The atmosphere of Saturn is estimated to be 12,000 miles thick with a pressure at the surface hundreds of times greater than that on earth. Its atmosphere is composed of methane, ammonia, and hydrogen. It is so cold, however, (about —250°F.) that most of the ammonia is crystallized out.

8 - b Uranus It is tilted nearly 98° to the perpendicular to the plane of the orbit, in contrast to the Earth's tilt of 23½°. This causes one pole to point almost directly to the sun, leaving the other in darkness as it rotates on its axis. This condition prevails for more than 40 years at a time as Uranus orbits around the sun.

9 - c Mercury The orbit of Mercury is very eccentric. At its closest approach to the sun, it is 15,000,000 miles nearer than at its most distant position. The average distance from the sun is 36,000,000 miles. The speed of revolution changes from 82,800 miles per hour to 126,000 miles per hour as it reaches its closest position to the sun. The increased speed prevents its being drawn into the sun.

10 - b One week As a day on the moon is two weeks long, nearly a week would pass between meals. Night is just as long—two weeks. The moon takes about four weeks to rotate once on its axis, compared with 24 hours for the Earth.

Score yourself:

9 - 10 right—You'll be the first to reach for a space travel folder.
4 - 8 right—Jet-age travel is your speed.
0 - 3 right—Start with a planetarium.

★ ★ ★ ★

A modern success story—the coyote

THE coyote wages its battle for survival without any help—and comes out easily ahead. The evening song of the "Western" coyote is heard from the outskirts of New York City to Miami and from Alaska to the wilds of Costa Rica, the National Geographic Society says. (An old-timer described the coyote's solo as a "prolonged wail which the animal lets out then runs after and bites into small pieces.")

To the growers of sheep and poultry, the coyote is Public Enemy No. 1. No other animal has been hunted more relentlessly with gun, poison, trap and hounds. Rocky Mountain cattlemen, however, contend that the war against coyotes has turned their ranches into Gardens of Eden for gophers.

Certainly, if the species were less intelligent, omnivorous, adaptable and prolific, it could not have spread out from its native West to places as alien as Westchester County, adjacent to New York. The coyote's favorite food is anything it can chew. There is an old Western saying, "Nobody ever saw a coyote starve to death, and nobody ever saw a fat one."

U.S.D.A. photos

A friend of mankind, except when angry, the bee gives us honey and pollinates flowers.

Man's eternal friends and enemies

Insects that harm us outnumber those that help us, and against them man is endlessly pitting his intelligence. But with their capacity to adapt, intelligence is losing.

WHEN primitive man made his debut on this planet, the insects were already there waiting for him. Indeed, fossils have been recovered which indicate that insects were well developed as far back as 300 million years ago. As with other life forms, the insects too had their evolutionary misfits which have vanished from the scene—such as the enormous cockroaches and dragonflies of the late Carboniferous period. These creatures, with wing

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One of man's troublesome six-legged enemies is famous "cotton-pickin'" boll weevil.

Given optimum conditions and enough cabbage, a cabbage aphis could beget 822 million tons of descendants a season.

spreads of more than two feet, were grotesque failures, but in time gave way to quite successful mutants.

The insect world today numbers some 800,000 species, and comprises four-fifths of all the animals on the earth. The majority of these species may be considered neutral in terms of their effects upon man. The remainder, again from man's point of view, can be said to play either a constructive or a destructive role.

Two sides of the coin

On the constructive side of the ledger is the part insects play as pollinating agents; at least fifty agricultural crops—including many important fruits and vegetables—depend on flower-visiting insects for pollination, or yield more abundantly when pollinating insects are present. Insects also help feed us in another indirect manner—by serving as food supply for many birds and fishes whose flesh eventually finds its way to our tables.

But on the destructive side, the havoc wrought by insects is so great that one may wonder whether insects or man will ultimately win sole domination of the planet. According to entomologist Dwight M. DeLong (Ohio State University), "Insects eat, steal, or destroy one-third of everything which man grows and stores for the future. . . ." Moreover, more direct and fatal attacks are delivered by the ectoparasites—those insects which feed on the blood of man. The World Health Organization, on the basis of information and statistics of member nations of the UN, estimates that insects are the cause of one-half of all human deaths, disease, and deformity. A single insect-borne disease, malaria, still infects one-sixth of the human race and claims a human life every ten seconds.

Clearly, if man is to survive as a species, he must hold in check his rivals of the insect world. But just why have insects proved so successful and dominant over much of the earth's surface? Professor DeLong provides us with a number of salient reasons.

The exoskeletons of chitin which enclose the insect body limits its size, but provides great strength due to direct muscle attachment. Since the chitin is essentially composed of such abundant elements as carbon, hydrogen, and nitrogen, the skeleton is always perfectly formed, even when no parent is present to select the diet. In contrast, the human infant requires years of carefully controlled nutrition to obtain a good skeletal structure and a healthy body.

As the only winged invertebrates, insects can readily abandon geographic areas which have become uninhabitable. While fishes and other aquatic forms usually perish when streams or lakes dry up, aquatic insects can often develop wings in time to avoid dessication and death.

Remarkable survival

Insect body temperatures usually rise and fall with external temperatures. But the composition of their protoplasm is such that it can function as a hydrophylic colloid, absorbing and binding the free water of the body. Thus, after a short period of conditioning, insects in every life stage can be subjected to freezing and even sub-freezing temperatures—and some will survive. Because of their low metabolic rate in winter, insects can survive even when no food is available.

Finally, insects have great biotic potential—the ability to reproduce rapidly and to establish enormous populations. Given optimum conditions, a single cabbage aphis and its descendants would—assuming enough cabbage were available—produce in a single season enough aphids (weight, one milligram each) to form a mass weighing 822 million tons—or five times the weight of the total human population.

Insects, it must be remembered, do not suffer from heart disease, that great killer of men. Having no lungs, liver, or kidneys, they are free of ailments affecting these organs. Most insects take care of themselves from birth, and none suffer from old age. As Professor DeLong puts the matter, "When their work is finished, they die. There is no retirement, no social security, no old age pensions, and never a feeble grandparent. All these problems have solutions in a world of insects as part of their adaptation."

There seems to be virtually no limit to the insect's capacity for adaptation. Certain insects, the grylloblattids, prefer temperatures of 0°; other insects can live in hot springs, where temperatures reach 124°. Perhaps one of the most amazing adaptations is seen in the-phydrid flies which live in saline, alkaline, or other solutions; they have been found in the Great Salt Lake, in Bohemian salt mines, in California's crude-oil pools—and in formaldehyde-preserved cadavers in medical schools.

Intelligence not enough

Regarding the rivalry between man and insect world, it is obvious that man's greatest asset is his intelligence. The insect, in contrast, is little more than a programmed bit of protoplasm. Yet it seems able to withstand every instrument which man's intelligence has created for its destruction. During the past two decades, man has used the most deadly of the chlorinated hydrocarbons and organic phosphates against insect pests, only to see descendants of these insects prove themselves

immune to the same chemical agents. In the battle of intelligence against biogenic adaptation, intelligence has lost one skirmish after another.

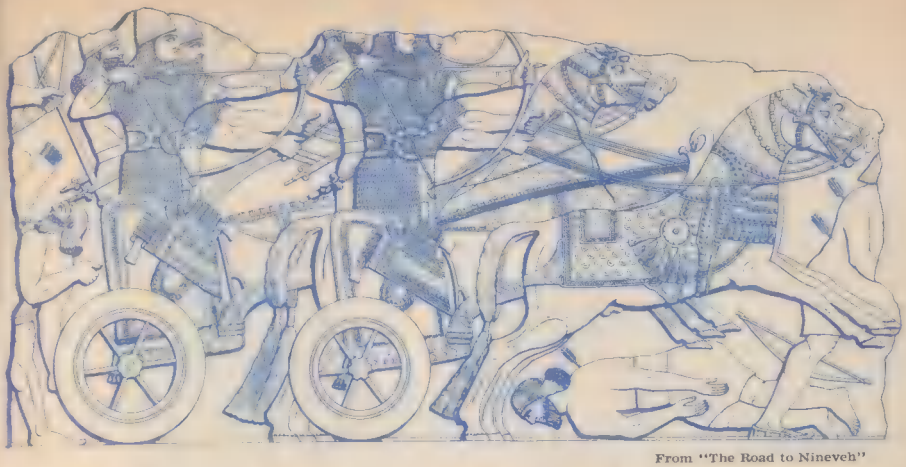
As an entomologist, Professor DeLong is compelled to admit that, ". . . nothing in the whole range of biological and paleontological study shows anything equal to the insect in its persistence and its potential complement of characteristics. . . . It seems reasonably certain from the past and present that the insect will persist and probably increase its position of dominance in the world."

Can as much be said for man? Will human intelligence enable us to solve such problems as the world population explosion, the dwindling of natural resources, the failure of many of our most promising pesticides, the increased ravaging of crops by insects, the increasing spread of many insect-borne diseases—and most deadly threat of all, the danger of a global, thermonuclear war?

The last living thing

In the event of such a war, the insects may well outlive and triumph over man, and may possess the planet as long as it is capable of sustaining life. Even then, to quote Dr. J. W. Holland's prophecy, ". . . The last living thing on this globe will be some active insect sitting on a dead lichen which will represent the last of the life of the plants."

"This horse seems almost human."



From "The Road to Nineveh"

He found the 'Bloody City'

THE Assyrians were just about the nastiest people in the history of the world. And the city of Nineveh was the very center of Assyrian wickedness.

In the Bible, the Lord orders Jonah, "Arise, go to Nineveh, that great city, and cry out against it; for their wickedness is come up against me." Nahum prophesies, "It shall come to pass that all they that look upon thee shall flee from thee, and say, Nineveh is laid waste: who will bemoan her?"

That's just about what happened. Nineveh was destroyed by her numerous enemies in 612 B.C. By the nineteenth century A.D., no one knew where the "Bloody City" had stood.

According to some legends, the ancient Assyrian capital lay buried under curious mounds in the bleak deserts of Mesopotamia, modern Iraq.

Then in 1839, an adventurous and romantic young man named Austen Henry Layard, left the security of a post in his uncle's London law office to travel the Orient.

Like most of us, Layard dreamed of a life of excitement in which he would become rich and famous and be able to leave behind a monument to his labors. Unlike most of us, he was able to accomplish just that.

Layard set out to join relatives in Ceylon, but he didn't get quite that far. In the Middle East, he became fascinated by the mounds and the stories attached to them.

Slowly he was transformed from youthful adventurer to serious excavator. But seriousness of purpose did not diminish the scope of his adventures.

The story of Layard's extraordinary life is told in an extremely readable biography by Nora Benjamin Kubie, *The Road to Nineveh,* (Doubleday, New York, $5.95.)

Miss Kubie tells her story straight, and that is enough, for Layard's life needs no embellishments to make thrilling reading. —*D.C.*

Three Lions Photos

A woman member of the panchayat, or village council, vigorously tries to convince a gaunt peasant that he should get a chest X-ray. Personal persuasion is necessary to get reluctant peasants to be examined, and be treated if ill.

Villager gets a chest X-ray from one of the mobile units that tour rural regions, stopping at every village. All examinations and treatment are supplied free by the Indian Government in effort to wipe out tuberculosis.

India fights the big cough

In India, over a million men, women and children die each year because of a false shame. TB sufferers will not seek treatment for the disease because they fear if their condition is "found out," their children will have a hard time getting married.

Dotta Kemmu, the big cough, is what Indians call tuberculosis. An estimated 6,000,000 Indians suffer from the disease. And each year, it kills 1,200,000 of them.

To fight the big cough, the Indian Public Health Service has enlisted the aid of the *panchayat,* or village councils

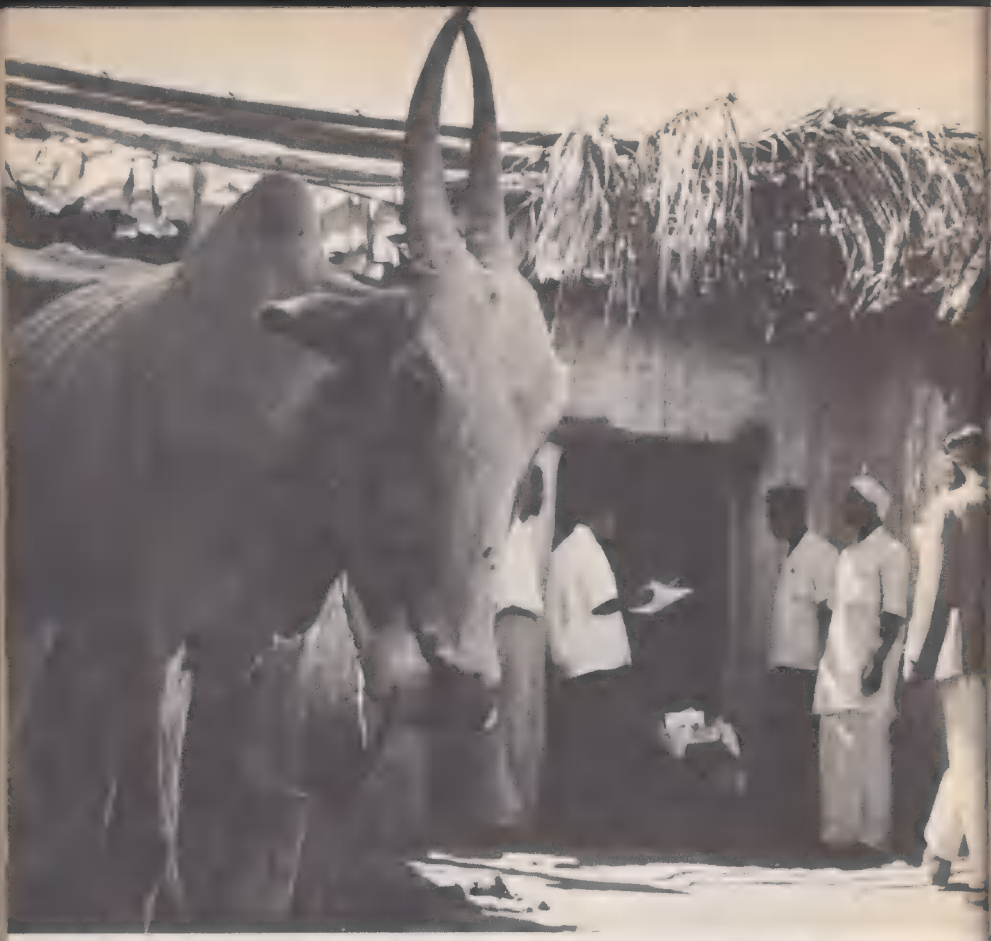
Examination, anti-TB drugs like isoniazid (isonicotinic acid hydrazide) and PAS (para amionosalicylic acid) and nursing care are all given free of charge. But before this can begin, teams of social workers carry the campaign to the peasants, many of whom oppose treatment.

One of the reasons peasants are reluctant to be treated for TB is that sons and daughters of tubercular parents are considered poor marriage prospects.

But the problem is much deeper than that.

In thousands of villages, the people live in incredible poverty. In one instance, it was discovered that the entire family had TB. When a social worker urged the peasant father and his children to get treatment, the father said, "What good would that be? If we were to take the wonder pills you give us and were we to get well, we'd want to eat more . . . and we wouldn't have enough food to eat then."

A patient watches anxiously as a doctor prepares a dose of "wonder pills."



Left: As thin as its stricken owner, this cow is tied to a post near the patient's farm house. Poor diet lowers resistance to bacillus.

Above: Villagers listen attentively to a speaker from the Public Health Service who tells them it is no disgrace to have tuberculosis.

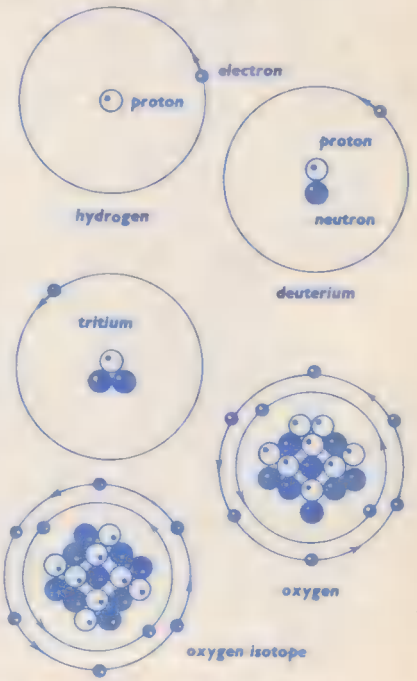
Below: Physicians hold an outdoor meeting with members of the village council in an area where most of the inhabitants have the disease.

YOUR SCIENCE ABC's

Isotopes

DIFFERENT YET THE SAME

THE atoms of which all substances are made are not little hard balls. They are very complicated arrangements of still tinier particles, the chief of which are called protons, neutrons and electrons. In the simplest atom of all, that of hydrogen, there are no neutrons and only one proton and one electron. The proton is about 1,837 times as heavy as the electron which revolves around it much as the earth goes around the sun. The atoms of other substances are built on the same pattern, only they have more protons in the center, or "nucleus," and more electrons revolving about it. They also have various numbers of neutrons mixed with the protons in the nucleus.



By adding or subtracting neutrons to the nucleus of an atom, an isotope is created. The element itself has not been changed.

Some radioactive isotopes have become important in medicine. Here cesium 137 is used to treat a patient for cancer.

Now, a proton carries a positive charge of electricity, and an electron a negative charge. In ordinary substances which are not electrified, the atoms all have an equal number

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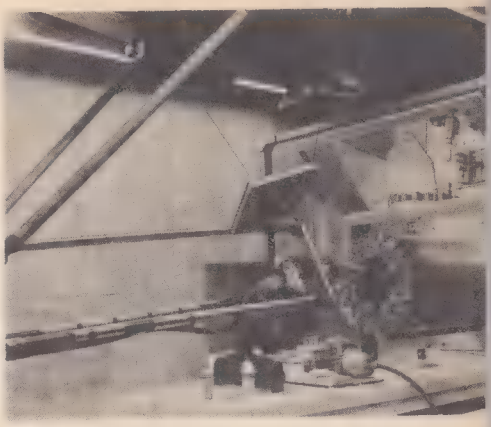
of protons and electrons, so that the positive charges exactly cancel out the negative charges. What makes an atom of one substance different from that of another is simply the number of protons it has. For example, there are 6 protons in a carbon atom, but 26 in an iron atom. This means that the carbon atom also has 6 electrons to neutralize the positive charge on the 6 protons, and the iron atom has 26 electrons, but we can forget about the electrons and think only of the protons in the nucleus. We can say that the difference between one substance and another lies in the electric charges carried in the centers of their atoms, for this describes how many protons they have. If you change the electric charge on the nucleus of an atom by removing or adding a proton to it, you change one element into another.

Move without change

But mixed with the protons are the neutrons, which have no electric charge at all, and you may remove or add one or more neutrons *without* changing one element into another. You simply make a lighter or heavier atom of the same element. Such different varieties of the same element are called "isotopes," and you cannot tell the difference between them by any ordinary means. They have exactly the same chemical properties, though they may show different sorts of radioactivity. You have doubtless heard of uranium 238 and uranium 235,



The "hot" radioactive isotope cobalt 60 is handled by remote-control equipment in a carefully shielded test chamber.

which are two isotopes of uranium. The atoms of the first contain 92 protons and 146 neutrons, and those of the second contain 92 protons and 143 neutrons. Apart from the slight difference in their weight, and their radioactive properties, that is all the difference there is between them.

Many common elements which are not radioactive, such as iodine, carbon, phosphorus and sodium, have rare radioactive isotopes. These can be manufactured by "cooking" the common forms inside an atomic pile. The heat does not affect them, but they are bombarded with myriads of protons, neutrons, electrons, gamma rays and other forms of radiation, and their atoms may either lose a few neutrons or collect a few. Different elements behave in different ways, and some lose protons as well as neutrons, and thus change from a non-radioactive isotope of

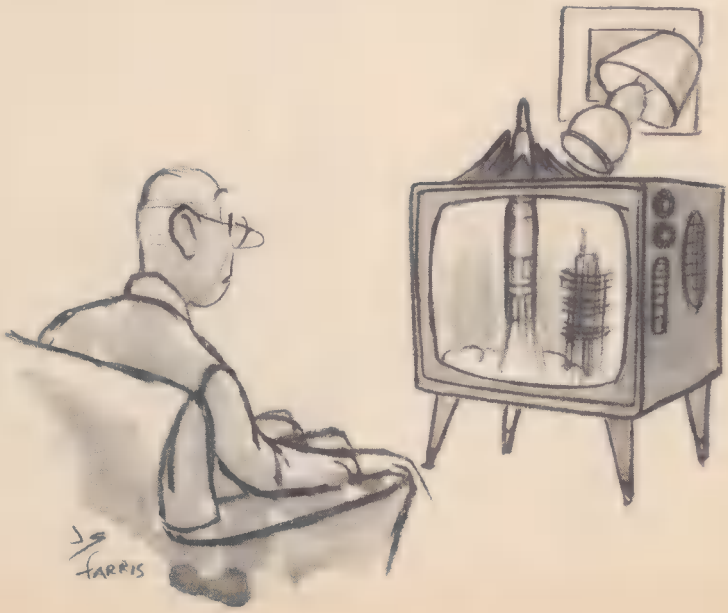
one element into a radioactive isotope of a different element.

For example, when cobalt 59 is bombarded with neutrons its atoms seize an extra neutron each and become cobalt 60. Cobalt 60 is strongly radioactive and is used by doctors for treating cancer, instead of radium, which is much more expensive.

Tracing radioactive isotopes

Radioactive isotopes are used in science and industry for many purposes. Some of them are employed as "tracers." For example, we know that the body needs iron, and that people who are short of it suffer from anemia. Doctors may give them a tonic containing iron, but may not be sure if they are able to digest or absorb it. So they include some of the radioactive isotope, iron-59, in the tonic. A few days later they can tell if the iron has found its way to the bone marrow, where it is most needed, by means of a Geiger counter, which can detect the radiations it gives off. Naturally, only harmless amounts of radiation can be permitted, but the Geiger counter is very sensitive and can detect the arrival of a single electron.

Of the 103 elements now known (including elements made by man), there are some 900 isotopes altogether, including both radioactive and non-radioactive isotopes.



the progress of MEDICINE

by Arthur J. Snider

The woman who stopped eating

SHE was 39 years old, 5 feet 6 inches tall and weighed 315 pounds. With the approval of her physician, she stopped eating. Only water and vitamins were consumed. After 117 days, she lost 116 pounds.

Most astonishing to Dr. Ernst J. Drenick of the University of California at Los Angeles was the ease with which prolonged starvation was tolerated. The longer the fast lasted, the easier it seemed for the patient. On putting an end to the patient's 117-day starvation regimen—the longest on record—Dr. Drenick said in the *Journal of the American Medical Association:* "It appears that the length of starvation which the individual patient will be able to tolerate is unpredictable."

The obese woman was one of 11 studied under conditions of starvation. The other 10 were men and their ages ranged from 32 to 71 and their weights from 240 to 450.

One was able to continue for only 12 days. Others were stopped at various times when they developed side effects.

Severe postural low blood pressure occurred in three. The drop in blood pressure on standing up produced weakness, fatigue, dizziness and blurred vision. While this occurred in one patient after only 12 days of starvation, it usually did not become noticeable until the third or fourth week.

Two patients developed gouty arthritis and four developed anemia, one severely.

Those who eventually attained a normal weight seemed to have

undergone marked changes in their eating habits and to eat substantially smaller amounts than prior to starvation. However, Dr. Drenick adds, the number of patients studied and the follow-up periods are too small to make any valid conclusions on long-range results.

There are indications, however, that starvation may be an easier way of losing weight than extremely low-caloric diets. While some side effects developed, the starvation patient in general lost physical endurance and energy only slowly. Severe weakness was uncommon. Younger patients actually seemed to remain fairly vigorous, while older patients required frequent short rests.

An editorial in the AMA Journal cautioned against prolonged starvation as a panacea. It said: "The desire of the starving but unhungry patient to effect a more drastic weight loss more quickly may induce him to extend the period of starvation. This can be dangerous."

Animal ills that hit humans

There are 64 "zoonoses" in the United States, and 23 of these hit man primarily where he works. Zoonoses is the scientific term for animal-borne diseases. Dr. Karl F. Meyer of San Francisco, a world-authority on animal-borne diseases, says they can provide some of the most "clinically terrifying" ailments known.

Anthrax is one of the foremost. It has been recognized since 1658 A.D., when it killed some 60,000 Europeans. It remains an actual or potential threat to butchers, veterinarians, skinners and shepherds.

Brucellosis, also called Malta Fever because it was first traced to goat herds on that Mediterranean island, has a remarkable ability to affect other animals, as well as man.

Leptospirosis, or Weil's Disease, is chiefly rat-borne but it also can be carried by dogs who can then transmit it to handlers.

Psittacosis, long thought to be confined to cage birds, has also been found in squabs, ducks, geese, chickens and turkeys. Violent outbreaks of psittacosis in poultry occurred in Texas in July, 1954, in Oregon in February, 1956, and in British Columbia in May, 1957.

The first heart transplant

He had been suffering from a chronic heart disease for several years. And now he was dying of terminal heart failure.

In a nearby room of the same hospital in Jackson, Miss., a second patient was dying of brain damage. Consent had been obtained from the family to transplant his heart to Patient No. 1.

But the clinical courses did not parallel. The heart patient was fail-

ing rapidly. Surgeons could no longer wait for the human heart. They resorted to an alternate plan. Kept in reserve was the heart of a chimpanzee.

In a three-hour operation, during which the heart patient was kept alive by an artificial heart-lung machine, the chimpanzee's heart was hooked up to the circulation. Then the heart-lung machine was turned off.

A forceful, regular beat was immediately established with a single shock of an electrical instrument. For the first time in history, a transplanted heart sustained a human being. The beat continued for an hour. But the patient died. The chimpanzee's heart was too small to maintain the body.

Nevertheless, the 11-man surgical team headed by Dr. James Hardy of the University of Mississippi was encouraged. Procedures previously worked out with animals also are effective in man, they said. Plans for further such operations have been drawn with the hope of "minimizing" the size disparity.

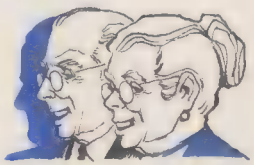
Men, women and health

Of all the developments flowering in the 20th Century, the progress of human health stands out.

Never has a newborn had so great an opportunity to achieve the Biblically-allotted three score and 10 years.

Motherhood is no longer a significant risk. Childbearing, once so hazardous, does not raise the mortality of a married woman above that of single women.

The chances of attaining a golden wedding anniversary have more than doubled. In 1900, there were only 19 chances in a hundred that a groom of 21 and a bride of 17 would survive to celebrate their 50th anniversary. At mid-century, the odds had risen to 42 in a hundred. Now more than 150,000 couples a year reach that mark.



Orphanhood, a major affliction in all societies, is for the first time diminishing as a social problem.

Working life expectancy was 31.1 years at the turn of the century. It was 42.3 in 1958. This has had the effect of increasing the labor force by a third.

Retirement life expectancy has doubled since 1900. A man at 20 could then look forward to an average retirement of 2.7 years. Now it is 6.5 years and the trend is upward.

These facts are documented in the new book, *Health Progress in the United States: 1900-1960*, published by the University of Chicago Press and written by Monroe Lerner of the Blue Cross Association and Prof. Odin W. Anderson, Health Information Foundation, University of Chicago.

But progress has brought its problems.

Mental illness has recently risen in importance to become one of the major health obstacles of our time. The authors attribute it to the fact that "Americans have become increasingly urbanized, educated, secularized and mobile, both geographically and socially, while family ties have become less cohesive, and roots in the community less firm."

Another social concomitant of health progress is a growing matriarchal society. The health of women is improving faster than that of men, leaving its mark upon the population structure.

By 1975, women will outnumber men 136 to 100, with the excess particularly significant in the 65 and over group. But even at mid-life, women will exceed men by 2,000,000.

Implied in these figures is a greater constitutional resistance to degenerative diseases on the part of women, which benefits them increasingly as infections and hazards of maternity come under tighter control.

But the authors also suggest that perhaps men more than women are subject to internal stress, "with a consequent higher incidence of coronary artery disease and ulcers."

That heart disease has become the new captain of death in the United States is well known. In 1900, one out of five deaths was ascribed to cardiovascular-renal diseases. By 1925, this had risen to one out of three and by 1960, to one out of two. It remains an unsolved problem.

Good news for diabetics

Pills for treatment of diabetes seem here to stay. Dr. Henry T. Ricketts, professor of medicine, University of Chicago, says these so-called oral hypoglycemic agents work extraordinarily well if the patients are properly selected. They are dismal failures if the patient is not properly selected. They work well only in patients whose diabetes begin in a mature age of life. They do not work at all in people with diabetes that began in childhood or adolescence.

The reason: The pills require that a certain amount of insulin be produced by the body (endogenous insulin) to be effective. The juvenile diabetic has no endogenous insulin that the oral agents are capable of releasing from the pancreas.

"Perhaps the best way of summarizing their effectiveness is to say that on the average they take the place of not more than 20 units of insulin, and patients who require much more insulin than this cannot as a rule be managed with the oral agents alone," Dr. Ricketts says.

Sorry, Empire State

By 1970 the Empire State Building, long the tallest building in the world, will be topped by the twin towers of the World Trade Center. If the new techniques used in constructing the Center prove economical, they may usher in an era of "super-skyscrapers" in our cities.

by Bruce H. Frisch

IN 1970, visitors to the Empire State Building will have to look *up* to see the sights. By then, New York's recently announced World Trade Center will rise 100 feet higher than the Empire State.

At 110 stories and 1,350 feet, it will be the tallest building in the world. In fact, it will be tallest twice over because of its twin towers.

And the new techniques making it possible probably mean that even taller buildings will follow.

As befits the world's tallest building, the Center will have the world's fastest elevators, traveling at 1,700 feet per minute.

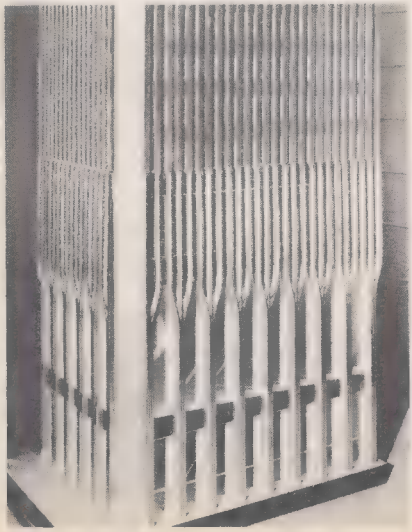
The Center will rise from the west side of lower Manhattan, which is spiked like a porcupine's tail with all but two of the buildings that have been "the world's tallest" at one time or another since 1899. The title moved uptown in 1930, first as the Chrysler Building beat out 40 Wall St. 1,046 to 900 feet by tacking on a secretly built stainless steel spire, and then to the 1,250-foot Empire State Building.

At 102 stories, the economic ceiling was reached. Additional stories would have cost more than they were worth in rent. After the war, construction costs climbed and the ceiling dropped. Recent skyscrapers have topped out around 60 stories.

The old ceiling has now been broached with a three-pronged attack by the Center's designers—Birmingham, Mich., architect Minoru Yamasaki (Federal Science Pavilion for the Seattle Fair); the New York firm, Emery Roth & Sons, and engineers and architects from the builder, the Port of New York Authority.

The first point of attack was the

The Center's closely spaced outside columns will eliminate the usual internal columns.



The encircled portion of west side lower Manhattan is where the Center will rise.

elevators; the invention that had made the skyscraper possible had also limited its height. Before Elisha Graves Otis had invented his hydraulic elevator in 1854, buildings had reached the stair-climber's fatigue limit of five or six stories. As buildings went higher, elevators took more and more space. Conventionally arranged elevators in the 110-story Center would eat up over half the floor area. The designers have reduced this bite by half by splitting the building into three stacked sections—from the first to the 40th story, from the 41st to the 73rd story and from the 74th to the 110th story. Instead of every elevator starting from the ground, locals serving each section will operate only in that section. Nonstop shuttles will feed passengers from the ground to skylobbies on the 41st and 74th floors. These tower elevators will be the fastest in the world, traveling at 1,700 feet per minute, or about as fast as a man runs doing a 10.6-second 100-yard dash. Altogether there will be 95 elevators in each tower.

Chief designer of Center is Birmingham, Michigan, architect Minoru Yamasaki.

Held up by walls

The second point of attack was to clear columns out of all the space between the outer walls and the central core of elevator shafts, thus boosting rentable area. Before the skyscraper, buildings were held up by their masonry walls. When elevators sent buildings higher, the walls had to be thicker to support the extra weight. One 16-story building in Chicago has walls six feet thick at the sidewalk.

The invention of a cheap method of making steel solved this problem. In 1884, William Le Baron Jenney built the first skyscraper, the Home Insurance Building in Chicago. It had a steel framework which carried all the load and set the pattern followed ever since. The wall was simply a thin curtain hung on the frame to separate the outside from the inside.

The Center will revert to the load-bearing wall, but this time it will be of steel. Closely spaced columns 39 inches apart center-to-center will be tied together to form the outer walls into the shape of an upright rectangular tube. The only other columns will be inside the central elevator core. The forest of in-

The center will be not only the world's tallest but also the world's largest building, surpassing the Pentagon and the Pan Am Building.

ternal columns that goes along with skeleton construction has been eliminated. Although a similar scheme has been used before, it has never been done on nearly this scale.

Filling the gaps between columns will be narrow, 22-inch wide, floor-to-ceiling windows. They and the towers are designed to take 100-mile-per-hour winds. The neighboring 60-story Chase Manhattan Bank Building has less trouble with windows blowing in than popping out. Seventeen seven-foot by four-and-a-half-foot panes on the down-wind side have been sucked out and dropped to the courtyard below. Designers of the Trade Center figure they will have no problems with their much narrower windows. Later they plan to test models in a wind tunnel to make sure.

The third maneuver that makes new heights economical is prefabrication. The Trade Center should go up like an erector set in chunks of outer wall two stories high by three columns wide. The floor will come in thirteen-foot-wide sections long enough to bridge the 60-foot gap between the core and outer wall.

All told, the project will cover 16 acres. Fourteen city blocks will be pounded to pieces, loaded in trucks and carted away. Then the builders will keep right on going 70 feet down to bedrock. On this slab of rock underlying Manhattan they will rest the 1,250,000 tons of the Center equal to 15 times the weight of the passenger liner Queen Elizabeth.

Builders in Manhattan consult a collection of old maps to find out what they will hit when they peel back the island's asphalt skin. One dating from 1783 shows the river shoreline 700 feet inland from the present one, so a good part of the site will be silt, shipwrecks and seawater. Borrowing a technique from Milan, Italy, subway diggers, the builders will first dig a trench around the site, then erect a wall in the trench to seal the excavation from mud and water.

Besides "world's tallest," the Center will also be the "world's largest." Today, both the Pentagon, with 24,000 workers, and the Pan American Building, with 17,000 workers and 2.4 million square feet of rentable floor area, have their backers. When completed, the Center will house a larger working population than the Pentagon and Pan American Building combined, 50,000. Its floor area will be over four times that of the Pan American Building, 10,000,000 square feet.

Sixty percent of the space is earmarked for a consolidation of the

city's state and federal offices, including U. S. Customs. The other 40 per cent will be rented mostly to the men who deal in the silks and spices, lathes and liquor carried on the ships that enter or leave New York harbor every 20 minutes.

All these offices should attract about 80,000 visitors each weekday. They can park their cars in a five-level, 1600-car underground garage or stay at a 250-room hotel. At noon they can join the crowds in the five-acre plaza. Surrounding the plaza and the towers will be a quadrangle of low buildings. These will be small enough to provide human contact and a scale by which to judge the towers. Achieving a human scale by breaking the towers into several large buildings "would have looked like a housing project," says Yamasaki.

As in all else, the Center costs more. The estimate is $350,000,000, compared to $90,000,000 for the Pan American Building and only $41,000,000 depression dollars for the Empire State Building. Yamasaki and his collaborators hope they have turned the trick of making it pay. If they do, they will probably have pioneered the way to their own outdoing.

Triple blimp

DIRIGIBLES have never been a popular form of air transportation. Yet they have a potential. They are inexpensive to build and they can be used for carrying heavy cargo such as large missile components and tanks over long distances.

So designers keep building them. Latest, and oddest entry in the dirigible derby is a triple-hulled monster called the *Aeron* (above).

Why three hulls? The designers, The Aeron Corp. of King of Prussia, Penna., cite these advantages: maximum aero-dynamic lift with minimum drag forces, and easier ground handling.

The *Aeron* is propelled by a two-bladed helicopter-type rotor, 21 feet in diameter (left). The rotor is attached to the stern of the middle hull.

Heat from the rotor's engine warms the helium in the hulls and provides controlled lift. *Aeron* should give the sagging blimp business a lift.

Science in the news

After trailing Russia for the first six and a half years of the space age, the United States roared into the lead. The Saturn-5 rose from Cape Kennedy to place in orbit a payload of 20,000 pounds, 5,708 more than the heaviest ever lifted by the Soviets. Liquid hydrogen fuel powered its previously unproved upper stage, reassuring scientists who are depending on such fuel for manned flight to the moon, maybe by 1970.

In instrumented exploration of the moon to prepare for a manned excursion, we suffered a new setback, but determined to try again. Ranger 6 hit the moon almost precisely on target, but the six TV cameras that were to flash back pictures before impact failed to operate. It was the sixth time Rangers had suffered a failure. Downcast NASA men, however, went to work to send up Ranger 7.

The intermediate project of sending two men into orbit, meanwhile, got a boost. The Titan II ICBM that will lift the Gemini capsule into space, maybe later this year, was fired successfully for the eighth time.

Amid the U.S. successes and failure, Russia chalked up a new achievement. It orbited two satellites with a single rocket. Object was to survey the Van Allen radiation belts that surround the earth. Main advantage: To speed the acquisition of space data.

Space made news in many other ways--practical, fantastic and even fearful: Britain indicated it will join with the U.S. and Continental countries in setting up a satellite communications system....The Soviet Union joined the U.S. in tracking one such satellite, Echo 2, and prepared to bounce signals off it....The Commerce Department and NASA agreed to set up a national weather satellite system....NASA began looking into fluorine as an oxidizer for liquid rocket fuels--boosting their power 50 percent or more....We also began examining the possibility of building rockets that can be used again, not discarded after each shot, as now....A Soviet astronomer offered new indications that the core of the Milky Way, our galaxy, is exploding....A fourth-generation Polaris missile is being considered with substantially increased payload/range capabilities--"a 90 per cent new bird."... The Administration revealed plans for a new ICBM, the Minuteman 2, with a range thought to extend to 9,000 miles....It also disclosed new electronic "spies" to detect Soviet missile launchings and nuclear space tests, including "over the horizon" radar.

President Johnson revealed three "Buck Rogers" weapons for conventional warfare: REDEYE--A shoulder weapon that fires a missile which seeks out the tail pipe of a jet. SHILLELAGH--A tank missile that can pinpoint another tank miles away. WALLEYE--An aerial bomb with a TV camera that shows the target to the pilot, who guides the bomb in.

R & D is more D than R. For the fiscal year 1965, President Johnson submitted a budget of which 15 percent or $15.3 billion is for research and development. Of that amount, scientists point out, about two-thirds is intended for space and military "hardware," one-third for research. For "basic" research, $1.8 billion is allocated, of which Defense and NASA are slated to get somewhat more than $1 billion.

As Presidential science adviser Donald F. Hornig was sworn in, his predecessor bowed out with some frank observations about the state of U.S. science. Jerome B. Wiesner said "the sweep and scope of American science are unexcelled." But he said we must double the output of scientists and engineers with higher degrees in the '60s. He added that we need better science education --better teaching, better pay for teachers and "more good students." Wiesner also said that Americans get 20 to 30 percent less house for their money than they would if builders fully exploited modern technology.

There's too much secrecy in government research. So said physicist Edward Teller. He told a House committee: "I am pretty well convinced the Russians have all our secrets and I am even afraid they have the secrets we will discover in the next two years." But he said it was an exaggeration to say Pentagon secrecy made industry suffer.

Plans for a U.S. supersonic transport were in a state of suspense. Lockheed, North American and Boeing offered their designs, from which the FAA was to make a selection by May 1. Two European airlines took options on the U.S. SST for such time as it was ready. But it wasn't clear when that might be. A study report for the President was said to advocate development by an independent agency and extreme caution to overcome the problems of flight at two or three times the speed of sound. Meanwhile, the Anglo-French Concorde--which will be slower and smaller but sooner than our SST --is failing to stir up as much airline interest as hoped. Reason: It'll be made of aluminum, which melts at 1,600 mph and will keep the plane's speed well below that.

A Hartford, Conn., man who lost his left hand had it sewed back on. It was severed by an ice-cutting machine. Nine doctors worked seven hours to reattach it. It's too early to tell whether it will function normally again....In another strange medical case, a dying woman in Seattle shared the blood of an incurable cancer patient for two days. Their blood circulated freely together and brought her through a crisis she suffered from a liver ailment. She died two weeks later of internal bleeding caused by her original condition.

New York's Dr. Alvan L. Barach to smokers: Can't give it up? Well, give up inhaling.

Britain quarreled scientifically with the U.S. and shook hands technologically with France. The quarrel: Within a few days, 18 British scientists said they were leaving their homeland, most of them for the U.S. Any more of the same, said the London Times, would "impoverish British universities." One reason given was America's better facilities. The handshake: London and Paris made it official that they would build a railroad tunnel under the Channel.

Add electronic marvels: RCA introduced a computer memory unit called RACE with the world's largest capacity: 681 million characters, enough to record five basic facts about every American....RCA Communications, Inc., demonstrated a computerized telegraph system that can handle 400,000 words a second; 100 words a minute is "fast" now.

QUOTE OF THE MONTH: "The primary justification for support of basic research in the social sciences is the same as that for the life or physical sciences --to enrich our understanding of the world we live in. A special challenge in pursuing such research comes from the difficulties of carrying on objective investigations in an area where unscientific ideas, misconceptions, and prejudices are often of ancient origin, deep-rooted, and of highly emotional content."--NATIONAL SCIENCE FOUNDATION, in its 13th Annual Report.

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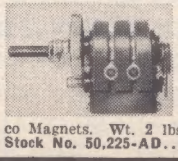

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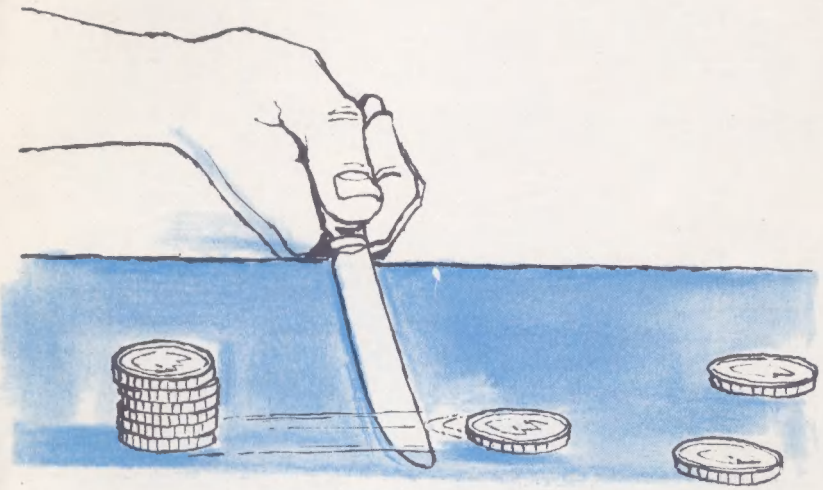

Dealing from the bottom

All things, from atoms to airplanes, have weight. This means that you have to use force to lift an object. In fact, you must use force to make things move in any direction.

All objects that are at rest try to stay at rest. The more suddenly you try to start them moving, the more they resist it. Scientists describe this by saying that all things have inertia.

To test this, stack up some quarters near the edge of a table that has a smooth top. Then, using a dinner knife, you can "slice" one coin after another out from the bottom of the stack. The other coins will not be bothered at all! Use a quick stroke, and keep the knife blade flat against the table.

In your experiment, the inertia of the coins in the stack kept them from going along with the one that was shoved by the knife.

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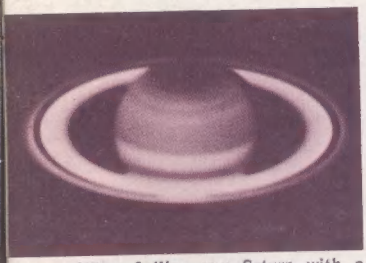
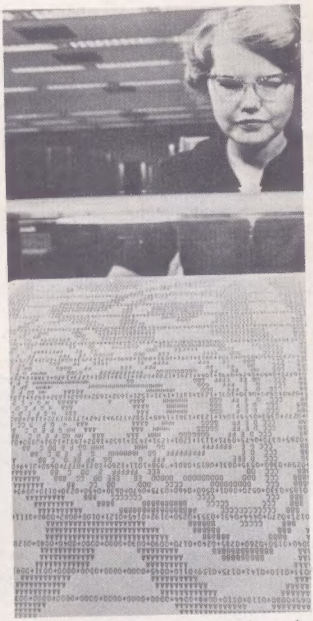
In this issue . . .

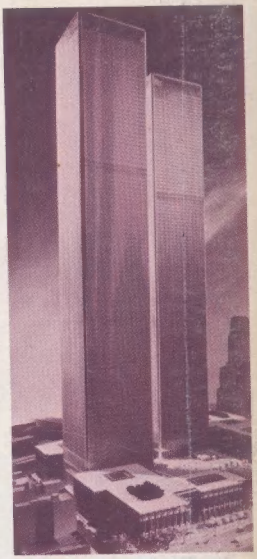
By living on a physician-directed diet of water and vitamins for 117 days, one woman lost 116 pounds. But not everyone can tolerate such diets. For the reasons why, see the story starting on page 81.



When Galileo saw Saturn with a telescope, he said it looked like it had "ears." We now know that it has rings, and even the humblest man can know more about the solar system than Galileo. How much do you know? See page 66.



Modern weathermen use tools such as high-speed computers and orbiting satellites. With all these wonders they still can't tell you, with any certainty if it will rain this afternoon. An explanation of this paradox begins on page 25.



By 1970, the twin towers of the World Trade Center in New York will top even the Empire State Building. The revolutionary new building techniques that will make this new "tallest building" possible will be used to change the skylines of many cities. Page 85.

A pessimist once speculated that the last living creature on earth will be an insect. The prediction is probably correct. Page 69.

In India, the sons and daughters of tubercular parents have a reduced chance of getting married. For fear that their children won't find mates, many Indians won't seek diagnosis or treatment for TB, though it kills 1 million of them each year. The Indian government is now trying to rid its people of a disease they won't admit they have. A picture story begins on page 74.